



# Paragon Analytics

## Radiochemistry Case Narrative

### Isotopic Thorium & Ac-227

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**Kent & Sullivan Inc.**

Ross Adams

PA WO 0405097

1. This report consists of the analytical results and supporting documentation for four soil samples received by Paragon on 05/11/04. It is noted that Paragon Analytics did not perform the drying and grinding procedure. The samples were sent to Hazen for this procedure, and were returned to Paragon on 6/8/04.
2. These samples were prepared according to Paragon Analytics procedures PA SOP773R8, PA SOP777R7, and PA SOP721R10. Modifications were made to the method as described on QASS 277615 and 277627.
3. The samples were analyzed for the presence of isotopic thorium and Ac-227 according to Paragon Analytics procedure PA SOP714R8 and R9. The analyses were completed on 07/07/04.
4. At the client's request, Ac-227 activity is reported in this analysis based on the alpha emissions of the first decay product, Th-227. The spectral "region-of-interest" for these alpha emissions is from approximately 5916 keV to 6038 keV, comprising 54.58% of the total emitted particles. This 54.58% alpha abundance is combined with the Th-227/Ac-227 branching ratio of 98.62% to produce a final abundance correction of 53.83%. This analytical approach assumes that Th-227 is fully ingrown with the Ac-227 parent nuclide. In addition, a decay correction factor is needed based on the date of Th-227 separation from Ac-227. For this purpose an 18.718 day half-life is used to decay correct the Th-227 activity to the date of preparation.
5. The isotopic analysis results for these samples are reported on a dry weight basis in units of pCi/gram.
6. Many of the samples in this work order were prepared at reduced aliquots due to elevated activity detected in gamma spectroscopic analyses of these samples. Due to the reduced aliquots taken for the preparation of these samples, the requested MDC of 0.1 pCi/gram was not achieved for the requested analytes. In each case, the amount of reportable activity exceeds the achieved MDC values. These samples are identified with an 'M3' flag on the final reports.
7. The method blank associated with these samples (AS040629-8MB) was also prepared at a similar reduced aliquot to facilitate an accurate comparison with the samples. Consequently, the requested MDC was not met for this method blank as well. It was only given a 300-

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minute count, but the achieved MDC values of this method blank are less than one fifth the activity measured in the associated samples, demonstrating that data quality is not affected by a shorter analysis time.

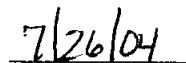
8. No further anomalous situations were encountered during the preparation or analysis of these samples. All remaining quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.



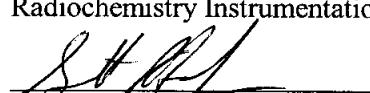
John Petrovic

Radiochemistry Instrumentation

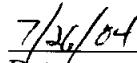


7/26/04

Date



Radiochemistry Final Data Review



7/26/04

Date

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PARAGON ANALYTICS  
Radiochemistry Data Package

Section 1

**SAMPLE RESULTS  
SUMMARY**

# Isotopic Thorium By Alpha Spec w/Ac-227 Sample Results Summary

Client Name: Kent & Sullivan Inc.

Client Project Name: Ross Adams

Client Project Number:

Laboratory Name: Paragon Analytics  
PAI Work Order: 0405097

Page: 1 of 2  
Reported on: Monday, July 26, 2004  
10:13:37 AM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0405097-19	700-01	Sample	Ac-227	71 +/- 25	18	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-19	700-01	Sample	Th-228	225 +/- 45	15	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-19	700-01	Sample	Th-230	472 +/- 85	15	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-19	700-01	Sample	Th-232	212 +/- 42	6	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-21	700-03	Sample	Ac-227	76 +/- 22	11	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-21	700-03	Sample	Th-228	292 +/- 54	9	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-21	700-03	Sample	Th-230	473 +/- 83	10	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-21	700-03	Sample	Th-232	218 +/- 41	2	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-23	900-01	Sample	Ac-227	28.6 +/- 6.9	2.7	pCi/g	SOLID	AS040629-8	7/7/2004	M3

## Comments:

### Data Package ID: ThAc0405097-1

#### Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

#### Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)
- BDL - Below Detection Limit

# Isotopic Thorium By Alpha Spec w/Ac-227 Sample Results Summary

Client Name: Kent & Sullivan Inc.

Client Project Name: Ross Adams

Client Project Number:

Laboratory Name: Paragon Analytics  
PAI Work Order: 0405097

Page: 2 of 2  
Reported on: Monday, July 26, 2004  
10:13:37 AM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0405097-23	900-01	Sample	Th-228	76 +/- 13	2	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-23	900-01	Sample	Th-230	202 +/- 34	2	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-23	900-01	Sample	Th-232	63 +/- 11	1	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-28	OSA-01	Sample	Ac-227	58 +/- 16	8	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-28	OSA-01	Sample	Th-228	192 +/- 35	5	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-28	OSA-01	Sample	Th-230	328 +/- 57	7	pCi/g	SOLID	AS040629-8	7/7/2004	M3
0405097-28	OSA-01	Sample	Th-232	158 +/- 29	2	pCi/g	SOLID	AS040629-8	7/7/2004	M3

## Comments:

## Data Package ID: ThAc0405097-1

### Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- Y1 - Chemical Yield is in control at 10-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Date Printed: Monday, July 26, 2004

Paragon Analytics  
LIMS Version: 5.042A

### Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)
- BDL - Below Detection Limit

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Section 2

**QC RESULTS  
SUMMARY**

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# Isotopic Thorium By Alpha Spec w/Ac-227

PAI 714 Rev 9

## Method Blank Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Lab ID: AS040629-8MB	Sample Matrix: SOLID Prep SOP: PAI 777 Rev 7 Date Collected: 30-Jun-04 Date Prepared: 30-Jun-04 Date Analyzed: 07-Jul-04	Prep Batch: AS040629-8 QCBatchID: AS040629-8-2 Run ID: AS040629-8B Count Time: 300 minutes	Final Aliquot: 0.0300 g Result Units: pCi/g File Name: T6298B
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
14952-40-0	Ac-227	1.8 +/- 3.6	7.5	U,M
14274-82-9	Th-228	0.8 +/- 2.4	5.3	U,M
14269-63-7	Th-230	0.6 +/- 2.5	5.6	U,M
7440-29-1	Th-232	-0.1 +/- 1.0	1.5	U,M

## Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	150.1	102	pCi/g	68.3	30 - 110 %	

## Comments:

### Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

### Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Data Package ID: THAC0405097-1

# Isotopic Thorium By Alpha Spec w/Ac-227

PAI 714 Rev 9

## Laboratory Control Sample(s)

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Lab ID: AS040629-8LCS	Sample Matrix: SOLID Prep SOP: PAI 777 Rev 7 Date Collected: 30-Jun-04 Date Prepared: 30-Jun-04 Date Analyzed: 07-Jul-04	Prep Batch: AS040629-8 QCBatchID: AS040629-8B Run ID: AS040629-8B Count Time: 300 minutes	Final Aliquot: 0.0300 g Result Units: pCi/g File Name: T6298L
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CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
14269-63-7	Th-230	158 +/- 28	5	150	105	85 - 121	P,M3

## Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	150.1	120	pCi/g	79.7	30 - 110 %	

## Comments:

### Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- L - LCS Recovery below lower control limit.
- H - LCS Recovery above upper control limit.
- P - LCS Recovery within control limits.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

### Abbreviations:

- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)

Data Package ID: THAC0405097-1

# Isotopic Thorium By Alpha Spec w/Ac-227

PAI 714 Rev 9

## Duplicate Sample Results (DER)

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 700-01  
Lab ID: 0405097-19DUP

Sample Matrix: SOLID  
Prep SOP: PAI 777 Rev 7  
Date Collected: 07-May-04  
Date Prepared: 30-Jun-04  
Date Analyzed: 07-Jul-04

Prep Batch: AS040629-8  
QCBatchID: AS040629-8-2  
Run ID: AS040629-8B  
Count Time: 300 minutes  
Report Basis: Dry Weight

Final Aliquot: 0.0101 g  
Prep Basis: Dry Weight  
Moisture(%): NA  
Result Units: pCi/g  
File Name: TA509719D

CASNO	Analyte	Sample Result +/- 2 s TPU	Duplicate Result +/- 2 s TPU	DER	Control Limit	Lab Qualifiers
14952-40-0	Ac-227	71 +/- 25	68 +/- 25	0.09		M3
14274-82-9	Th-228	225 +/- 45	241 +/- 48	0.25	2.13	M3
14269-63-7	Th-230	472 +/- 85	474 +/- 87	0.02	2.13	M3
7440-29-1	Th-232	212 +/- 42	213 +/- 43	0.02	2.13	M3

### Comments:

#### Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

LT - Result is less than Request MDC, greater than sample specific MDC

M - Requested MDC not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

#### Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

DER - Duplicate Error Ratio

BDL - Below Detection Limit

NR - Not Reported

Data Package ID: THAC0405097-1

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Section 3

**INDIVIDUAL  
SAMPLE RESULTS**

# Isotopic Thorium By Alpha Spec w/Ac-227

PAI 714 Rev 9

## Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 700-01 Lab ID: 0405097-19	Sample Matrix: SOLID Prep SOP: PAI 777 Rev 7 Date Collected: 07-May-04 Date Prepared: 30-Jun-04 Date Analyzed: 07-Jul-04	Prep Batch: AS040629-8 QCBatchID: AS040629-8-2 Run ID: AS040629-8B Count Time: 300 minutes Report Basis: Dry Weight	Final Aliquot: 0.0101 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: TA509719
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
14952-40-0	Ac-227	71 +/- 25	18	M3
14274-82-9	Th-228	225 +/- 45	15	M3
14269-63-7	Th-230	472 +/- 85	15	M3
7440-29-1	Th-232	212 +/- 42	6	M3

## Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	444.9	357	pCi/g	80.2	30 - 110 %	

## Comments:

### Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

### Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: THAC0405097-1

Date Printed: Monday, July 26, 2004

Paragon Analytics

LIMS Version: 5.042A

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# Isotopic Thorium By Alpha Spec w/Ac-227

PAI 714 Rev 9

## Sample Duplicate Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 700-01 Lab ID: 0405097-19DUP	Sample Matrix: SOLID Prep SOP: PAI 777 Rev 7 Date Collected: 07-May-04 Date Prepared: 30-Jun-04 Date Analyzed: 07-Jul-04	Prep Batch: AS040629-8 QCBatchID: AS040629-8-2 Run ID: AS040629-8B Count Time: 300 minutes Report Basis: Dry Weight	Final Aliquot: 0.0101 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: TA509719D
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
14952-40-0	Ac-227	68 +/- 25	18	M3
14274-82-9	Th-228	241 +/- 48	11	M3
14269-63-7	Th-230	474 +/- 87	15	M3
7440-29-1	Th-232	213 +/- 43	4	M3

## Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	444.9	333	pCi/g	74.9	30 - 110 %	

## Comments:

### Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

### Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: THAC0405097-1

# Isotopic Thorium By Alpha Spec w/Ac-227

PAI 714 Rev 9

## Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 700-03 Lab ID: 0405097-21	Sample Matrix: SOLID Prep SOP: PAI 777 Rev 7 Date Collected: 07-May-04 Date Prepared: 30-Jun-04 Date Analyzed: 07-Jul-04	Prep Batch: AS040629-8 QCBatchID: AS040629-8B Run ID: AS040629-8B Count Time: 300 minutes Report Basis: Dry Weight	Final Aliquot: 0.0145 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: TA509721
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
14952-40-0	Ac-227	76 +/- 22	11	M3
14274-82-9	Th-228	292 +/- 54	9	M3
14269-63-7	Th-230	473 +/- 83	10	M3
7440-29-1	Th-232	218 +/- 41	2	M3

## Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	310.1	252	pCi/g	81.2	30 - 110 %	

## Comments:

### Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

### Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: THAC0405097-1

# Isotopic Thorium By Alpha Spec w/Ac-227

PAI 714 Rev 9

## Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: 900-01 Lab ID: 0405097-23	Sample Matrix: SOLID Prep SOP: PAI 777 Rev 7 Date Collected: 07-May-04 Date Prepared: 30-Jun-04 Date Analyzed: 07-Jul-04	Prep Batch: AS040629-8 QCBatchID: AS040629-8-2 Run ID: AS040629-8B Count Time: 300 minutes Report Basis: Dry Weight	Final Aliquot: 0.0670 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: TA509723
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
14952-40-0	Ac-227	28.6 +/- 6.9	2.7	M3
14274-82-9	Th-228	76 +/- 13	2	M3
14269-63-7	Th-230	202 +/- 34	2	M3
7440-29-1	Th-232	63 +/- 11	1	M3

## Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	67.19	52.4	pCi/g	78.0	30 - 110 %	

## Comments:

### Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

### Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: THAC0405097-1

# Isotopic Thorium By Alpha Spec w/Ac-227

PAI 714 Rev 9

## Sample Results

Lab Name: Paragon Analytics

Work Order Number: 0405097

Client Name: Kent & Sullivan Inc.

ClientProject ID: Ross Adams

Field ID: OSA-01 Lab ID: 0405097-28	Sample Matrix: SOLID Prep SOP: PAI 777 Rev 7 Date Collected: 06-May-04 Date Prepared: 30-Jun-04 Date Analyzed: 07-Jul-04	Prep Batch: AS040629-8 QCBatchID: AS040629-8B Run ID: AS040629-8B Count Time: 300 minutes Report Basis: Dry Weight	Final Aliquot: 0.0183 g Prep Basis: Dry Weight Moisture(%): NA Result Units: pCi/g File Name: TA509728
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CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
14952-40-0	Ac-227	58 +/- 16	8	M3
14274-82-9	Th-228	192 +/- 35	5	M3
14269-63-7	Th-230	328 +/- 57	7	M3
7440-29-1	Th-232	158 +/- 29	2	M3

## Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
Th-229	246.1	205	pCi/g	83.1	30 - 110 %	

## Comments:

### Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

### Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: THAC0405097-1

**PARAGON ANALYTICS**  
**Radiochemistry Data Package**

**Section 4**

**4**

**RAW DATA**

# Isotopic Thorium By Alpha Spec w/Ac-227 Raw Data Report

Laboratory Name: Paragon Analytics  
 PAI Work Order: 0405097

Prep SOP: PAI 777  
 Analytical SOP: PAI 714  
 Reported on: Monday, July 26, 2004  
 9:43:56 AM

Sample ID QC Type	Nuclide Type	Sample Date/Time	Prep Batch QCBatchID	Ingrowth Date/Time	Decay Date/Time	Matrix % Moist.	Samp Alq Analy Alq	Inst ID Det ID	AnRunID File Name	Count Date/Time	Net Cnts Bkg Cnts	BaseEff Bkg/min	CntDur(min)	Activity +/- Yield	MDC	ReportUnits ReportBasis	DER RPD	%Spk. Recov Flags
0405097-19	Ac-227	5/7/2004 5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	46,100	28.53%	300	71	18	pCi/g	NA	M3
SMP	Trg. Analyte	5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	13,000	1000	80.2%	25	NA	Dry Weight	NA	M3
0405097-19	Th-228	5/7/2004 5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	330,000	28.53%	300	225	15	pCi/g	NA	M3
SMP	Trg. Analyte	5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	60,000	1000	80.2%	45	NA	Dry Weight	NA	M3
0405097-19	Th-229	5/7/2004 5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	693,900	28.53%	300	357	5	pCi/g	NA	
SMP	Tracer	5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	7,000	1000	80.2%	59	NA	Dry Weight	NA	
0405097-19	Th-230	5/7/2004 5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	735,591	28.53%	300	472	15	pCi/g	NA	M3
SMP	Trg. Analyte	5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	61,362	1000	80.2%	85	NA	Dry Weight	NA	M3
0405097-19	Th-232	5/7/2004 5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	330,200	28.53%	300	212	6	pCi/g	NA	
SMP	Trg. Analyte	5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	6,000	1000	80.2%	42	NA	Dry Weight	NA	M3
0405097-19	Ac-227	5/7/2004 5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	41,000	28.78%	300	68	18	pCi/g	0.09	
DUP	Trg. Analyte	5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	10,000	1000	74.9%	25	NA	Dry Weight	NA	M3
0405097-19	Th-228	5/7/2004 5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	330,100	28.78%	300	241	11	pCi/g	0.25	
DUP	Trg. Analyte	5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	23,000	1000	74.9%	48	NA	Dry Weight	NA	M3
0405097-19	Th-229	5/7/2004 5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	646,700	28.78%	300	333	3	pCi/g	NA	
DUP	Tracer	5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	1,000	1000	74.9%	55	NA	Dry Weight	NA	
0405097-19	Th-230	5/7/2004 5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	688,362	28.78%	300	474	15	pCi/g	0.02	
DUP	Trg. Analyte	5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	55,461	1000	74.9%	87	NA	Dry Weight	NA	M3
0405097-19	Th-232	5/7/2004 5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	309,400	28.78%	300	213	4	pCi/g	0.02	
DUP	Tracer	5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	2,000	1000	74.9%	43	NA	Dry Weight	NA	M3
0405097-19	Th-238	5/7/2004 5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0101 g	Alpha Spec	AS040629-8B	7/7/2004 10:13 AM	70,300	28.56%	300	76	11	pCi/g	NA	
DUP	Trg. Analyte	5:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0145 g	Alpha Spec	AS040629-8B	7/7/2004 10:14 AM	9,000	1000	81.2%	22	NA	Dry Weight	NA	M3
0405097-21	Ac-227	5/7/2004 5:20:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0145 g	Alpha Spec	AS040629-8B	7/7/2004 10:14 AM	TA5097121							
SMP	Trg. Analyte	5:20:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	SOLID	0.0145 g	Alpha Spec	AS040629-8B	7/7/2004 10:14 AM	TA5097121							

## Comments:

## Data Package ID: ThAC0405097-1

### Qualifiers/Flags:

U - Result is less than the sample specific MDC.  
 Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.  
 Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42  
 D - DER is greater than Control Limit of 2.13  
 + - Duplicate RPD not within limits.

L - LCS Recovery above upper control limit.  
 P - LCS, Matrix Spike Recovery within control limits  
 N - Matrix Spike Recovery below lower control limit  
 NC - Not Calculated for duplicate results less than 5 times MDC  
 B - Analyte concentration greater than MDC  
 B3 - Analyte concentration greater than MDC but less than Requested MDC  
 # - Aliquot Basis is 'As Received' while the Report Basis is 'As Received'.  
 \* - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

- Notes:**
- 1) The Tracer results are not yield corrected (i.e. activity measured not activity added).
  - 2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

### Abbreviations:

TR - Tracer TA - Target Analyte  
 TPU - Total Propagated Uncertainty (see PAI SOP 743)  
 MDC - Minimum Detectable Concentration (see PAI SOP 709)  
 DER - Duplicate Error Ratio  
 BDL - Below Detection Limit

# Isotopic Thorium By Alpha Spec w/Ac-227 Raw Data Report

Laboratory Name: Paragon Analytics  
 PAI Work Order: 0405097

Prep SOP: PAI 777  
 Analytical SOP: PAI 714

Reported on: Monday, July 26, 2004  
 9:43:56 AM

Sample ID QC Type	Nuclide Type	Sample Date/Time	Prep Batch QCBatchID	Ingrowth Date/Time	Decay Date/Time	Matrix %Moist.	Samp Alq Analy Alq	Inst ID Det ID	AnRunID File Name	Count Date/Time	Net Cnts Bkg Cnts	BaseEff Bkg/min	CritDur(min) Yield	Activity +/- 2 s TPU	MDC	ReportUnits ReportBasis	DER RPD	%Spk. Recov Flags
0405097-21	Th-228	5/7/2004 5:20:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	39,000	1000	81.2%	300	292	9	pCi/g	NA
SMP	Trig. Analyte	5/7/2004 5:20:00 PM	AS040629-8	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	696,000	28,56%	300	252	1	pCi/g	NA	
0405097-21	Th-230	5/7/2004 5:20:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	0,000	1000	81.2%	41	NA	Dry Weight	NA	
SMP	Trig. Analyte	5/7/2004 5:20:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	1062,439	28,56%	300	473	10	pCi/g	NA	
0405097-21	Th-232	5/7/2004 5:20:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	58,536	1000	81.2%	83	NA	Dry Weight	NA	
SMP	Trig. Analyte	5/7/2004 5:20:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	488,700	28,56%	300	248	2	pCi/g	NA	
0405097-23	Ac-227	5/7/2004 1:00:00 PM	AS040629-8	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	1,000	1000	81.2%	41	NA	Dry Weight	NA	
SMP	Trig. Analyte	5/7/2004 1:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	133,500	32,35%	300	286	2.7	pCi/g	NA	
0405097-23	Th-228	5/7/2004 1:00:00 PM	AS040629-8	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	15,000	1000	78.0%	69	NA	Dry Weight	NA	
SMP	Trig. Analyte	5/7/2004 1:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	800,900	32,35%	300	76	2	pCi/g	NA	
0405097-23	Th-228	5/7/2004 1:00:00 PM	AS040629-8	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	77,000	1000	78.0%	13	NA	Dry Weight	NA	
SMP	Trig. Analyte	5/7/2004 1:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	756,900	32,35%	300	524	0.7	pCi/g	NA	
0405097-23	Th-230	5/7/2004 1:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	7,000	1000	78.0%	85	NA	Dry Weight	NA	
SMP	Trig. Analyte	5/7/2004 1:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	2274,029	32,35%	300	202	2	pCi/g	NA	
0405097-23	Th-232	5/7/2004 1:00:00 PM	AS040629-8	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	66,570	1000	78.0%	34	NA	Dry Weight	NA	
SMP	Trig. Analyte	5/7/2004 1:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	707,100	32,35%	300	63	1	pCi/g	NA	
0405097-23	Th-232	5/7/2004 1:00:00 PM	AS040629-8	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:14 AM	3,000	1000	78.0%	11	NA	Dry Weight	NA	
SMP	Trig. Analyte	5/7/2004 1:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:15 AM	9,000	1000	83.1%	16	NA	Dry Weight	NA	
0405097-23	Th-232	5/7/2004 2:00:00 PM	AS040629-8-2	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:15 AM	576,900	31,60%	300	152	5	pCi/g	NA	
SMP	Trig. Analyte	5/7/2004 2:00:00 PM	AS040629-8	NA	6/30/2004 1:47:00 PM	NA	0.0145 g	Alpha Spec	AS040629-B-B	7/7/2004 10:15 AM	27,000	1000	83.1%	35	NA	Dry Weight	NA	
0405097-23	Th-228	5/6/2004 2:00:00 PM	AS040629-8-2	NA	NA	NA	0.0145 g	Alpha Spec	AS040629-B-B	TA050728	10:15 AM	NA	NA	NA	NA	NA	NA	
SMP	Trig. Analyte	5/6/2004 2:00:00 PM	AS040629-8	NA	NA	NA	0.0145 g	Alpha Spec	AS040629-B-B	TA050728	10:15 AM	NA	NA	NA	NA	NA	NA	

## Comments:

## Data Package ID: ThAc0405097-1

### Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at [0-110%]. Quantitative yield is assumed.
- Y2 - Chemical Yield outside default limits.
- W - DER is greater than Warning Limit of 1.42
- D - DER is greater than Control Limit of 2.13
- + - Duplicate RPD not within limits.
- L/T - Result is less than Request MDC; greater than sample specific MDC
- \* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
- # - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

- M - Requested MDC not met.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
- L - LCS Recovery below lower control limit.
- H - LCS Recovery above upper control limit.
- P - LCS - Matrix Spike Recovery within control limits
- N - Matrix Spike Recovery outside control limits
- NC - Not Calculated for duplicate results less than 5 times MDC
- B - Analyte concentration greater than MDC.
- B3 - Analyte concentration greater than MDC but less than Requested MDC.

Notes:

- 1) The Tracer results are not yield corrected (i.e. activity measured not activity added).
- 2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

### Abbreviations:

- TR- Tracer
- TA- Target Analyte
- TPU - Total Propagated Uncertainty (see PAI SOP 743)
- MDC - Minimum Detectable Concentration (see PAI SOP 709)
- DER - Duplicate Error Ratio
- BDL - Below Detection Limit

# Isotopic Thorium By Alpha Spec w/Ac-227 Raw Data Report

Laboratory Name: Paragon Analytics  
 PAI Work Order: 0405097

Prep SOP: PAI 777  
 Analytical SOP: PAI 714

Reported on: Monday, July 26, 2004  
 9:43:56 AM

Sample ID QC Type	Nuclide Type	Sample Date/Time	Prep Batch QCBatchID	Ingrowth Date	Decay Date/Time	Matrix % Moist.	Samp Alq Analy Alq	Inst ID Det ID	AnRunID File Name	Count	Net Crits Bkg Crits	BaseEff Bkg/min	CntDur(min)	Activity +/-	MDC	ReportUnits ReportBasis	DER RPD	%Spk. Recov Flags
0405097-28	Th-229	5/6/2004	AS040629-8	NA	6/30/2004	SOLID	0.0183 g	42	AS040629-8B	7/7/2004	787,800	31.60%	300	205	2	pCi/g	NA	
SMP	Tracer	2:00:00 PM	AS040629-4-2	NA	1:47:00 PM	NA	0.0183 g	42	TA509728	10:15 AM	4,000	1000	83.1%	33	NA	Dry Weight	NA	
0405097-28	Th-230	5/6/2004	AS040629-8	NA	6/30/2004	SOLID	0.0183 g	42	AS040629-8B	7/7/2004	1050,463	31.60%	300	328	7	pCi/g	NA	
SMP	Trg. Analyte	2:00:00 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.0183 g	42	TA509728	10:15 AM	65,125	1000	83.1%	57	NA	Dry Weight	NA	
0405097-28	Th-232	5/6/2004	AS040629-8	NA	6/30/2004	SOLID	0.0183 g	42	AS040629-8B	7/7/2004	504,700	31.60%	300	158	2	pCi/g	NA	
SMP	Trg. Analyte	2:00:00 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.0183 g	42	TA509728	10:15 AM	1,000	1000	83.1%	29	NA	Dry Weight	NA	
AS040629-8	Ac-227	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	60	AS040629-8B	7/7/2004	2,700	26.17%	300	1.8	7.5	pCi/g	NA	
MB	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	60	T6298B	10:21 AM	11,000	1000	68.3%	36	NA	Dry Weight	NA	
AS040629-8	Th-228	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	60	AS040629-8B	7/7/2004	3,000	26.17%	300	53	5.3	pCi/g	NA	
MB	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	60	T6298B	10:21 AM	40,000	1000	68.3%	24	NA	Dry Weight	NA	
AS040629-8	Th-229	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	60	AS040629-8B	7/7/2004	535,900	26.17%	300	102	2	pCi/g	NA	
MB	Tracer	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	60	T6298B	10:21 AM	7,000	1000	68.3%	17	NA	Dry Weight	NA	
AS040629-8	Th-230	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	60	AS040629-8B	7/7/2004	2,110	26.17%	300	0.6	5.6	pCi/g	NA	
MB	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	60	T6298B	10:21 AM	46,301	1000	68.3%	25	NA	Dry Weight	NA	
AS040629-8	Th-232	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	60	AS040629-8B	7/7/2004	-0.300	26.17%	300	-0.1	1.5	pCi/g	NA	
MB	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	60	T6298B	10:21 AM	1,000	1000	68.3%	1.0	NA	Dry Weight	NA	
AS040629-8	Th-229	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	60	AS040629-8B	7/7/2004	720,800	30.14%	300	120	1	pCi/g	NA	
LCS	Tracer	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	61	T6298L	10:21 AM	4,000	1000	79.7%	20	NA	Dry Weight	NA	
AS040629-8	Th-230	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	61	AS040629-8B	7/7/2004	760,524	30.14%	300	158	5	pCi/g	NA	
LCS	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	61	T6298L	10:21 AM	61,586	1000	79.7%	28	NA	Dry Weight	NA	
AS040629-8	Th-229	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	30.14%	300	120	1	pCi/g	NA		
LCS	Tracer	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	4,000	1000	79.7%	20	NA	Dry Weight	NA	
AS040629-8	Th-230	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	61,586	1000	79.7%	158	5	pCi/g	NA	
LCS	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	1,000	1000	79.7%	28	NA	Dry Weight	NA	
AS040629-8	Th-229	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	720,800	30.14%	300	120	1	pCi/g	NA	
LCS	Tracer	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	4,000	1000	79.7%	20	NA	Dry Weight	NA	
AS040629-8	Th-230	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	61,586	1000	79.7%	158	5	pCi/g	NA	
LCS	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	1,000	1000	79.7%	28	NA	Dry Weight	NA	
AS040629-8	Th-229	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	720,800	30.14%	300	120	1	pCi/g	NA	
LCS	Tracer	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	4,000	1000	79.7%	20	NA	Dry Weight	NA	
AS040629-8	Th-230	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	61,586	1000	79.7%	158	5	pCi/g	NA	
LCS	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	1,000	1000	79.7%	28	NA	Dry Weight	NA	
AS040629-8	Th-229	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	720,800	30.14%	300	120	1	pCi/g	NA	
LCS	Tracer	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	4,000	1000	79.7%	20	NA	Dry Weight	NA	
AS040629-8	Th-230	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	61,586	1000	79.7%	158	5	pCi/g	NA	
LCS	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	1,000	1000	79.7%	28	NA	Dry Weight	NA	
AS040629-8	Th-229	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	720,800	30.14%	300	120	1	pCi/g	NA	
LCS	Tracer	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	4,000	1000	79.7%	20	NA	Dry Weight	NA	
AS040629-8	Th-230	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	61,586	1000	79.7%	158	5	pCi/g	NA	
LCS	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	1,000	1000	79.7%	28	NA	Dry Weight	NA	
AS040629-8	Th-229	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	720,800	30.14%	300	120	1	pCi/g	NA	
LCS	Tracer	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	4,000	1000	79.7%	20	NA	Dry Weight	NA	
AS040629-8	Th-230	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	61,586	1000	79.7%	158	5	pCi/g	NA	
LCS	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	1,000	1000	79.7%	28	NA	Dry Weight	NA	
AS040629-8	Th-229	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	720,800	30.14%	300	120	1	pCi/g	NA	
LCS	Tracer	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	4,000	1000	79.7%	20	NA	Dry Weight	NA	
AS040629-8	Th-230	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	61,586	1000	79.7%	158	5	pCi/g	NA	
LCS	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	1,000	1000	79.7%	28	NA	Dry Weight	NA	
AS040629-8	Th-229	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	720,800	30.14%	300	120	1	pCi/g	NA	
LCS	Tracer	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	4,000	1000	79.7%	20	NA	Dry Weight	NA	
AS040629-8	Th-230	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	61,586	1000	79.7%	158	5	pCi/g	NA	
LCS	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	1,000	1000	79.7%	28	NA	Dry Weight	NA	
AS040629-8	Th-229	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	720,800	30.14%	300	120	1	pCi/g	NA	
LCS	Tracer	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	4,000	1000	79.7%	20	NA	Dry Weight	NA	
AS040629-8	Th-230	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	61,586	1000	79.7%	158	5	pCi/g	NA	
LCS	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	1,000	1000	79.7%	28	NA	Dry Weight	NA	
AS040629-8	Th-229	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	720,800	30.14%	300	120	1	pCi/g	NA	
LCS	Tracer	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	4,000	1000	79.7%	20	NA	Dry Weight	NA	
AS040629-8	Th-230	6/30/2004	AS040629-8	NA	6/30/2004	SOLID	0.03 g	Alpha Spec	AS040629-8B	7/7/2004	61,586	1000	79.7%	158	5	pCi/g	NA	
LCS	Trg. Analyte	1:47:48 PM	AS040629-8-2	NA	1:47:00 PM	NA	0.03 g	Alpha Spec	AS0406									

# Paragon Analytics

## Alpha Spectroscopy Analysis

Report Printed:  
7/23/04 10:04:37 AM

Para0327.rpt  
rev 11/13/03 KVG

**Sample Name:** 0405097-19 TAAS040629-8

**Analysis Type:** Th/Ac

**Detector:** MCB 3 Input 5

**Date/Time of Count:** 7/7/04 10:13:14 AM

**Sample Volume:** 0.010 Total, 0.010 Aliquot.

**Live Time:** 300.00 Minutes

**Chem. Yield:** 80.27%

**Real Time:** 300.01 Minutes

**Total Eff.:** 23.14 %

**Dead Time:** 0.0 %

**Tracer Amount:** 9.995 DPM, With Contaminant

**Acquisition:** 512 Channels

**Efficiency:** 28.83%

**Analysis:** Relative Region-Of-Interest

**Original:** 2,987 + 10.4577 \* Chn + -0.00180 \* Chn \*\*2.

**Spectrum Calibration:** 2,987 + 10.5205 \* Chn + -0.00180 \* Chn \*\*2.

**Cal File:**

**Spectrum File:** C:\User\Alpha\ALPHA\TA509719.SPC

**Background File:** C:\User\Alpha\ALPHA\B4070621.SPC

**Library File:** C:\User\Alpha\ALPHAVIS.ALB

### Peaks

<b>Peak</b>	<b>Channel</b>	<b>Start</b>	<b>End</b>	<b>FWHM</b>	<b>Height</b>	<b>Gross Cts</b>	<b>Bkg Cts</b>	<b>Net Area</b>	<b>DPM</b>
1	166.36	145	171	4.00	72.00	754.00	1.20	735.59	10.59
2	99.17	76	107	2.00	43.00	332.00	1.80	330.20	4.76
3	242.22	222	247	2.00	38.00	348.00	18.00	330.00	4.75
4	306.01	293	311	2.00	6.00	50.00	3.90	46.10	0.66
Tracer	182.26	172	208	14.00	53.00	696.00	2.10	693.90	9.99

### Analysis Results

<b>Peak</b>	<b>Nuclide</b>	<b>Energy (keV)</b>	<b>Width (keV)</b>	<b>Aliquot pCi</b>	<b>MDA pCi</b>	<b>% Error</b>
1	Th-230	4687.70	39.69	477.252	n/a	7.32 %
2	Th-232	4013.00	20.33	214.234	n/a	10.82 %
3	Th-228	5430.00	19.30	214.104	n/a	11.11 %
4	Th-227	6038.21	18.84	29.910	n/a	30.17 %
Tracer	Th-229	4845.00	138.10	450.203	n/a	7.43 %

### Totals

**% Total**

Gross Count:	2,837.00	100.00
Net Area:	2,719.10	95.84
Background:	117.90	4.16
Composite Fit:	2,180.00	76.84
Residuals:	657.00	23.16

000020

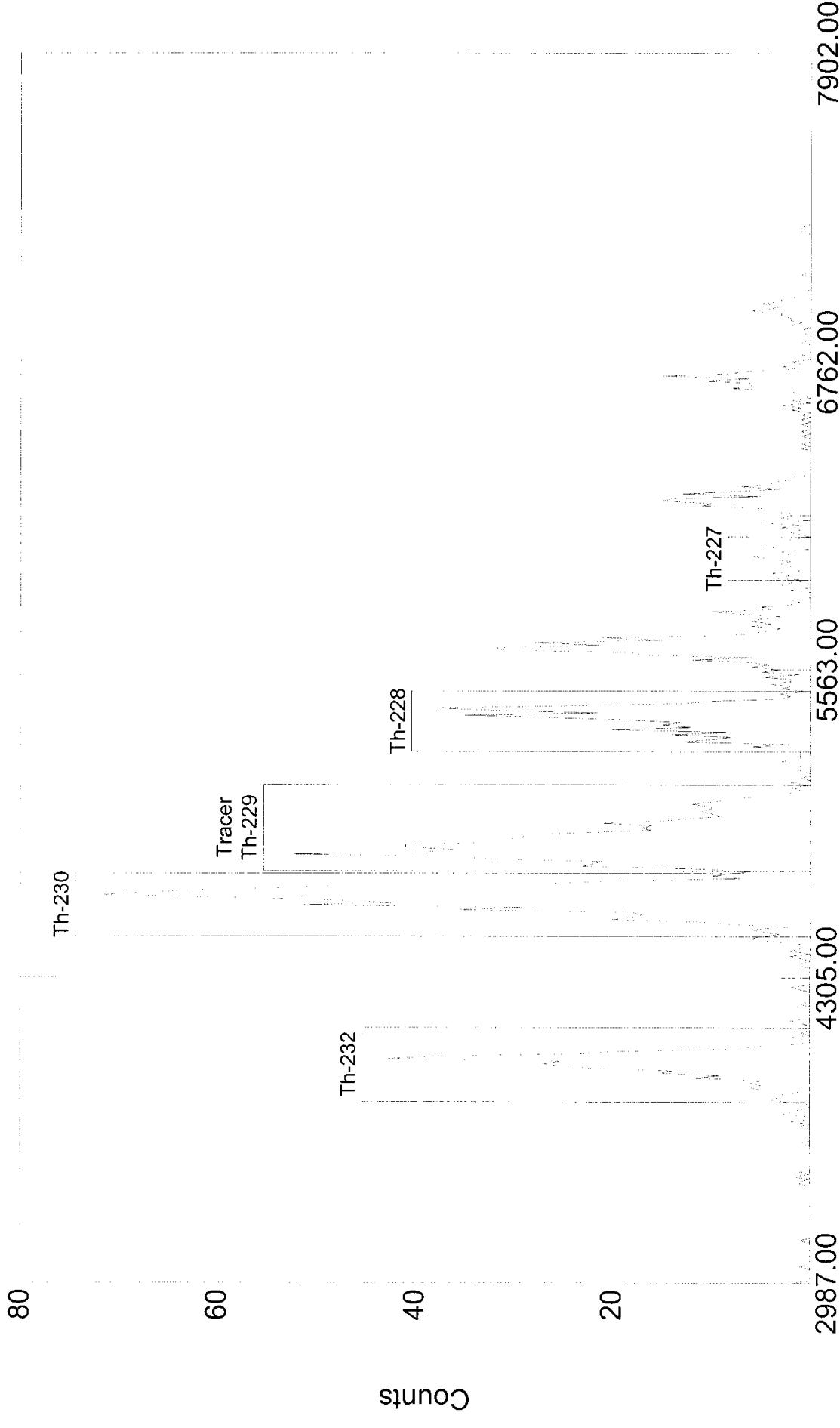
Analyzed By: *Sm*

Checked By: *JP*

000021

TA509719

AlphaVision Relative Region-Of-Interest (Slope Recalibration)



000022

Acquired: 10:13:14 on 07-Jul-2004  
File: C:\User\Alpha\ALPHA\TA509719.SPC  
Sample: 0405097-19 TAAS040629-8  
Real Time: 18000.62 s. Live Time: 18000.00 s.  
Detector: #21 MCB 3 Input 5  
Type: Th/AC

# Paragon Analytics

## Alpha Spectroscopy Analysis

Report Printed:  
7/23/04 10:05:43 AM

Para0327.rpt  
rev 11/13/03 KVG

**Sample Name:** 0405097-19D TAAS040629-8

**Analysis Type:** Th/Ac

**Detector:** MCB 3 Input 6

**Date/Time of Count:** 7/7/04 10:13:43 AM

**Sample Volume:** 0.010 Total, 0.010 Aliquot.

**Live Time:** 300.00 Minutes

**Chem. Yield:** 74.94%

**Real Time:** 300.01 Minutes

**Total Eff.:** 21.57 %

**Dead Time:** 0.0 %

**Tracer Amount:** 9.995 DPM, With Contaminant

**Acquisition:** 512 Channels

**Efficiency:** 28.78%

**Analysis:** Relative Region-Of-Interest

**Original:** 3,020 + 10.1601 \* Chn + -0.00097 \* Chn \*\*2.

**Spectrum Calibration:** 3,020 + 10.1816 \* Chn + -0.00097 \* Chn \*\*2.

**Cal File:**

**Spectrum File:** C:\User\Alpha\ALPHA\TA509719D.SPC

**Background File:** C:\User\Alpha\ALPHA\B4070622.SPC

**Library File:** C:\User\Alpha\ALPHAVIS.ALB

### Peaks

<b>Peak</b>	<b>Channel</b>	<b>Start</b>	<b>End</b>	<b>FWHM</b>	<b>Height</b>	<b>Gross Cts</b>	<b>Bkg Cts</b>	<b>Net Area</b>	<b>DPM</b>
1	166.43	145	172	4.00	91.00	705.00	0.60	688.36	10.64
2	98.45	75	106	4.00	42.00	310.00	0.60	309.40	4.78
3	242.29	223	248	4.00	42.00	337.00	6.90	330.10	5.10
4	305.32	291	309	2.00	7.00	44.00	3.00	41.00	0.63
Tracer	182.41	173	208	10.00	54.00	647.00	0.30	646.70	9.99

### Analysis Results

<b>Peak</b>	<b>Nuclide</b>	<b>Energy (keV)</b>	<b>Width (keV)</b>	<b>Aliquot pCi</b>	<b>MDA pCi</b>	<b>% Error</b>
1	Th-230	4687.70	39.43	479.206	n/a	7.56 %
2	Th-232	4013.00	39.96	215.390	n/a	11.15 %
3	Th-228	5430.00	38.85	229.800	n/a	10.91 %
4	Th-227	6038.21	19.18	28.542	n/a	31.81 %
Tracer	Th-229	4845.00	98.28	450.203	n/a	7.71 %

### Totals

% Total

Gross Count:	2,724.00	100.00
Net Area:	2,639.70	96.91
Background:	84.30	3.09
Composite Fit:	2,043.00	75.00
Residuals:	681.00	25.00

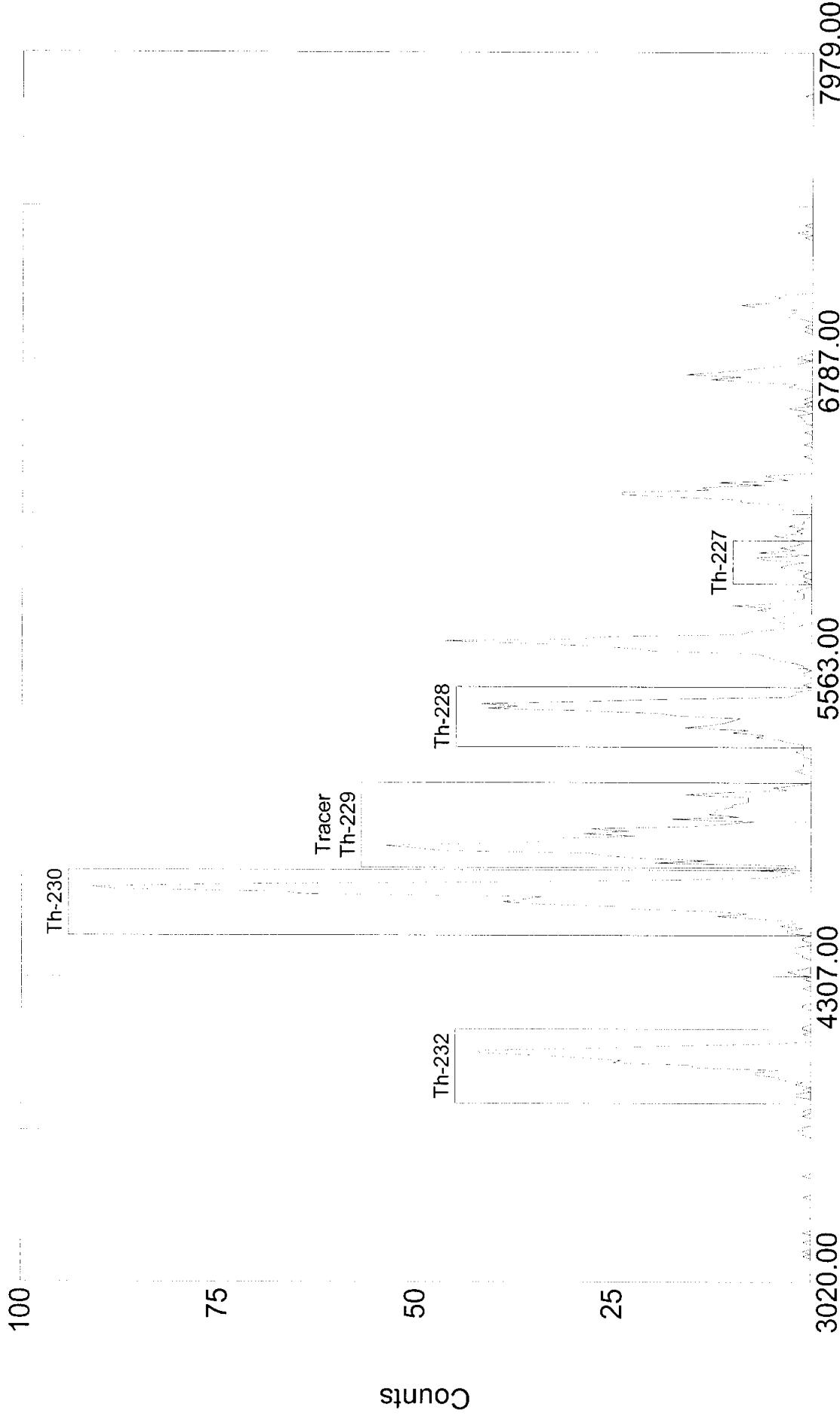
000023

Analyzed By: *Sm*

Checked By: *JP*

TA509719D

AlphaVision Relative Region-Of-Interest (Slope Recalibration)



000025

Acquired: 10:13:43 on 07-Jul-2004

File: C:\User\Alpha\ALPHA\TA509719D.SPC

Sample: 0405097-19D TAAS040629-8

Energy (keV)

Real Time: 18000.62 s. Live Time: 18000.00 s.

Detector: #22 MCB 3 Input 6

Type: Th/AC

# Paragon Analytics

## Alpha Spectroscopy Analysis

Report Printed:  
 7/23/04 10:07:01 AM  
 Para0327.rpt  
 rev 11/13/03 KVG

**Sample Name:** 0405097-21 TAAS040629-8

**Analysis Type:** Th/Ac

**Detector:** MCB 3 Input 7

**Date/Time of Count:** 7/7/04 10:14:13 AM

**Sample Volume:** 0.010 Total, 0.010 Aliquot.

**Live Time:** 300.00 Minutes

**Chem. Yield:** 81.28%

**Real Time:** 300.01 Minutes

**Total Eff.:** 23.21 %

**Dead Time:** 0.0 %

**Tracer Amount:** 9.995 DPM, With Contaminant

**Acquisition:** 512 Channels

**Efficiency:** 28.56%

**Analysis:** Relative Region-Of-Interest

**Original:** 3,016 + 10.0990 \* Chn + -0.00081 \* Chn \*\*2.

**Spectrum Calibration:** 3,016 + 10.0724 \* Chn + -0.00081 \* Chn \*\*2.

**Cal File:**

**Spectrum File:** C:\User\Alpha\ALPHA\TA509721.SPC

**Background File:** C:\User\Alpha\ALPHA\B4070623.SPC

**Library File:** C:\User\Alpha\ALPHAVIS.ALB

### Peaks

<b>Peak</b>	<b>Channel</b>	<b>Start</b>	<b>End</b>	<b>FWHM</b>	<b>Height</b>	<b>Gross Cts</b>	<b>Bkg Cts</b>	<b>Net Area</b>	<b>DPM</b>
1	168.28	145	170	2.00	126.00	1,080.00	0.30	1062.44	15.26
2	99.83	76	107	2.00	59.00	489.00	0.30	488.70	7.02
3	244.50	222	247	2.00	90.00	628.00	11.70	616.30	8.85
4	307.68	294	312	6.00	11.00	73.00	2.70	70.30	1.01
Tracer	184.35	171	208	10.00	51.00	696.00	0.00	696.00	9.99

### Analysis Results

<b>Peak</b>	<b>Nuclide</b>	<b>Energy (keV)</b>	<b>Width (keV)</b>	<b>Aliquot pCi</b>	<b>MDA pCi</b>	<b>% Error</b>
1	Th-230	4687.70	19.60	687.231	n/a	6.06 %
2	Th-232	4013.00	19.82	316.112	n/a	8.87 %
3	Th-228	5430.00	19.36	398.649	n/a	7.98 %
4	Th-227	6038.21	57.45	45.473	n/a	23.86 %
Tracer	Th-229	4845.00	97.75	450.203	n/a	7.43 %

### Totals

**% Total**

Gross Count:	3,876.00	100.00
Net Area:	3,780.90	97.55
Background:	95.10	2.45
Composite Fit:	2,966.00	76.52
Residuals:	910.00	23.48

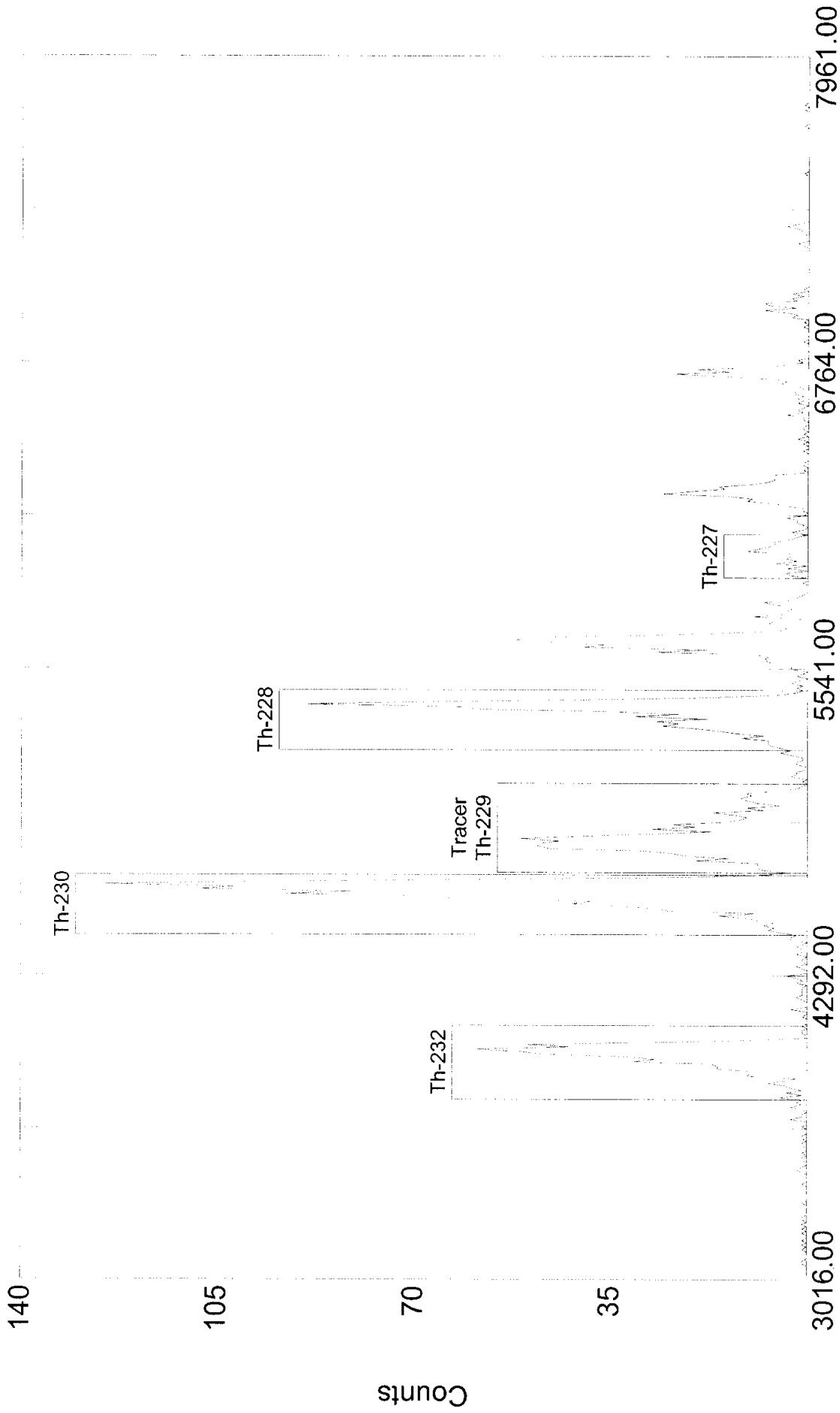
000026

Analyzed By: Sm

Checked By: JP

TA509721

AlphaVision Relative Region-Of-Interest (Slope Recalibration)



000028

Acquired: 10:14:13 on 07-Jul-2004  
Real Time: 18000.64 s. Live Time: 18000.00 s.  
File: C:\User\Alpha\AL PHA\TA509721.SPC  
Detector: #23 MCB 3 Input 7  
Sample: 0405097-21 TAAS040629-8  
Type: Th/Ac

# Paragon Analytics

## Alpha Spectroscopy Analysis

Report Printed:  
7/23/04 10:08:09 AM

Para0327.rpt  
rev 11/13/03 KVG

**Sample Name:** 0405097-23 TAAS040629-8

**Analysis Type:** Th/Ac

**Detector:** MCB 3 Input 8

**Date/Time of Count:** 7/7/04 10:14:48 AM

**Sample Volume:** 0.070 Total, 0.070 Aliquot.

**Live Time:** 300.00 Minutes

**Chem. Yield:** 78.03%

**Real Time:** 300.01 Minutes

**Total Eff.:** 25.24 %

**Dead Time:** 0.0 %

**Tracer Amount:** 9.995 DPM, With Contaminant

**Acquisition:** 512 Channels

**Efficiency:** 32.35%

**Analysis:** Relative Region-Of-Interest

**Original:** 3,053 + 9.8648 \* Chn + -0.00034 \* Chn \*\*2.

**Spectrum Calibration:** 3,053 + 9.8865 \* Chn + -0.00034 \* Chn \*\*2.

**Cal File:**

**Spectrum File:** C:\User\Alpha\ALPHA\TA509723.SPC

**Background File:** C:\User\Alpha\ALPHA\B4070624.SPC

**Library File:** C:\User\Alpha\ALPHAVIS.ALB

### Peaks

<b>Peak</b>	<b>Channel</b>	<b>Start</b>	<b>End</b>	<b>FWHM</b>	<b>Height</b>	<b>Gross Cts</b>	<b>Bkg Cts</b>	<b>Net Area</b>	<b>DPM</b>
1	166.34	145	171	6.00	229.00	2,294.00	1.20	2274.03	30.03
2	97.47	74	105	6.00	79.00	708.00	0.90	707.10	9.34
3	242.50	223	247	6.00	94.00	824.00	23.10	800.90	10.58
4	305.21	292	311	8.00	12.00	138.00	4.50	133.50	1.76
Tracer	182.44	172	208	10.00	58.00	759.00	2.10	756.90	9.99

### Analysis Results

<b>Peak</b>	<b>Nuclide</b>	<b>Energy (keV)</b>	<b>Width (keV)</b>	<b>Aliquot pCi</b>	<b>MDA pCi</b>	<b>% Error</b>
1	Th-230	4687.70	58.64	193.227	n/a	4.13 %
2	Th-232	4013.00	58.92	60.083	n/a	7.38 %
3	Th-228	5430.00	58.32	68.053	n/a	7.03 %
4	Th-227	6038.21	77.42	11.344	n/a	17.27 %
Tracer	Th-229	4845.00	97.62	64.315	n/a	7.11 %

### Totals

**% Total**

Gross Count:	6,164.00	100.00
Net Area:	6,049.10	98.14
Background:	114.90	1.86
Composite Fit:	4,723.00	76.62
Residuals:	1,441.00	23.38

000023

Analyzed By: *Sm*

Checked By: *JP*

TA509723

AlphaVision Relative Region-Of-Interest (Slope Recalibration)

280

Th-230

210

Counts

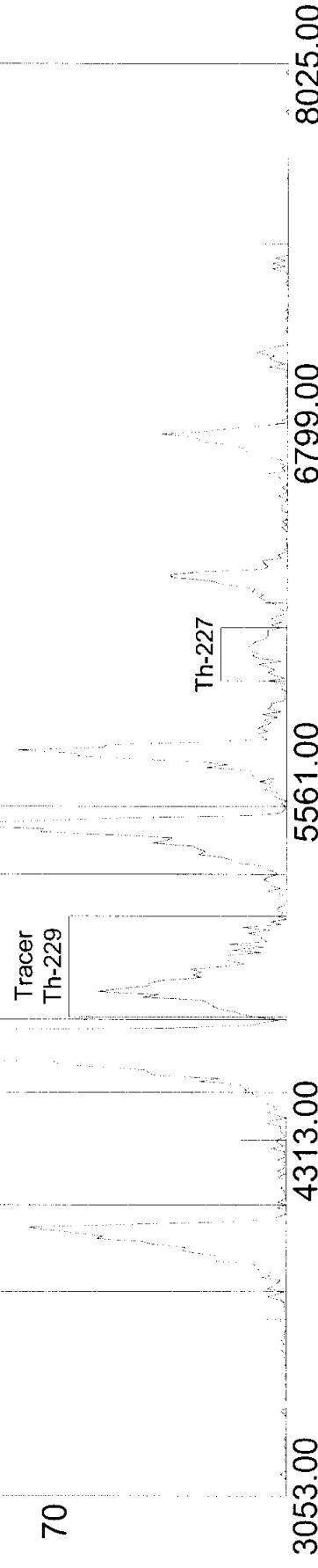
140

70  
3053.00

Th-232

Th-228

Tracer  
Th-229



Acquired: 10:14:48 on 07-Jul-2004

File: C:\User\Alpha\ALPHA\TA509723.SPC

Sample: 0405097-23 TAAS040629-8

Energy (keV)  
Real Time: 18000.62 s. Live Time: 18000.00 s.

Detector: #24 MCB 3 Input 8

Type: Th/AC

00003

# Paragon Analytics

## Alpha Spectroscopy Analysis

Report Printed:  
7/23/04 10:09:20 AM  
Para0327.rpt  
rev 11/13/03 KVG

**Sample Name:** 0405097-28 TAAS040629-8

**Analysis Type:** Th/Ac

**Detector:** MCB 6 Input 2

**Date/Time of Count:** 7/7/04 10:15:29 AM

**Sample Volume:** 0.020 Total, 0.020 Aliquot.

**Live Time:** 300.00 Minutes

**Chem. Yield:** 83.15%

**Real Time:** 300.26 Minutes

**Total Eff.:** 26.27 %

**Dead Time:** 0.1 %

**Tracer Amount:** 9.995 DPM, With Contaminant

**Acquisition:** 512 Channels

**Efficiency:** 31.60%

**Analysis:** Relative Region-Of-Interest

**Original:**  $2,973 + 10.4170 * \text{Chn} + -0.00120 * \text{Chn}^{**2}$ .

**Spectrum Calibration:**  $2,973 + 10.3231 * \text{Chn} + -0.00120 * \text{Chn}^{**2}$ .

**Cal File:**

**Spectrum File:** C:\User\Alpha\ALPHA\TA509728.SPC

**Background File:** C:\User\Alpha\ALPHA\B4070642.SPC

**Library File:** C:\User\Alpha\ALPHAVIS.ALB

### Peaks

<b>Peak</b>	<b>Channel</b>	<b>Start</b>	<b>End</b>	<b>FWHM</b>	<b>Height</b>	<b>Gross Cts</b>	<b>Bkg Cts</b>	<b>Net Area</b>	<b>DPM</b>
1	169.43	146	172	4.00	131.00	1,070.00	0.00	1050.46	13.33
2	101.94	77	108	2.00	58.00	505.00	0.30	504.70	6.40
3	244.97	221	247	2.00	74.00	585.00	8.10	576.90	7.32
4	307.94	291	311	2.00	9.00	79.00	2.70	76.30	0.97
Tracer	185.32	173	210	12.00	64.00	789.00	1.20	787.80	9.99

### Analysis Results

<b>Peak</b>	<b>Nuclide</b>	<b>Energy (keV)</b>	<b>Width (keV)</b>	<b>Aliquot pCi</b>	<b>MDA pCi</b>	<b>% Error</b>
1	Th-230	4687.70	39.67	300.153	n/a	6.10 %
2	Th-232	4013.00	20.16	144.210	n/a	8.73 %
3	Th-228	5430.00	19.47	164.840	n/a	8.22 %
4	Th-227	6038.21	19.17	21.802	n/a	22.87 %
Tracer	Th-229	4845.00	118.54	225.101	n/a	6.98 %

### Totals

**% Total**

Gross Count:	4,071.00	100.00
Net Area:	3,990.00	98.01
Background:	81.00	1.99
Composite Fit:	3,028.00	74.38
Residuals:	1,043.00	25.62

000032

Analyzed By: *Sm*

Checked By: *JP*

000033

TA509728

AlphaVision Relative Region-Of-Interest (Slope Recalibration)

160

Th-230

120

Counts

80

Tracer  
Th-229

Th-232

40

2973.00

4275.00

5537.00

6760.00

7944.00

000034

Energy (keV)

Acquired: 10:15:29 on 07-Jul-2004  
Real Time: 18015.64 s. Live Time: 18000.00 s.

File: C:\User\Alpha\ALPHA\TA509728.SPC  
Sample: 0405097-28 TAAS040629-8

Detector: #42 MCB 6 Input 2  
Type: Th/Ac

# Paragon Analytics

## Alpha Spectroscopy Analysis

Report Printed:  
7/23/04 2:40:46 PM  
Para0327.rpt  
rev 11/13/03 KVG

**Sample Name:** AS040629-8MB TAS040629-8

**Analysis Type:** Th/Ac

**Detector:** MCB 8 Input 4

**Date/Time of Count:** 7/7/04 10:21:06 AM

**Sample Volume:** 0.030 Total, 0.030 Aliquot.

**Live Time:** 300.00 Minutes

**Chem. Yield:** 68.27%

**Real Time:** 300.01 Minutes

**Total Eff.:** 17.87 %

**Dead Time:** 0.0 %

**Tracer Amount:** 9.999 DPM, With Contaminant

**Acquisition:** 512 Channels

**Efficiency:** 26.17%

**Analysis:** Relative Region-Of-Interest

**Original:** 3,038 + 9.8969 \* Chn + -0.00059 \* Chn \*\*2.

**Spectrum Calibration:** 3,038 + 9.8005 \* Chn + -0.00059 \* Chn \*\*2.

**Cal File:**

**Spectrum File:** C:\User\Alpha\ALPHA\T6298B.SPC

**Background File:** C:\User\Alpha\ALPHA\B4070660.SPC

**Library File:** C:\User\Alpha\ALPHAVIS.ALB

### Peaks

<b>Peak</b>	<b>Channel</b>	<b>Start</b>	<b>End</b>	<b>FWHM</b>	<b>Height</b>	<b>Gross Cts</b>	<b>Bkg Cts</b>	<b>Net Area</b>	<b>DPM</b>
1	170.08	146	170	2.00	2.00	16.00	0.60	2.11	0.04
2	100.09	75	106	0.00	0.00	0.00	0.30	-0.30	-0.01
3	247.77	223	248	2.00	5.00	15.00	12.00	3.00	0.06
4	311.99	298	316	2.00	2.00	6.00	3.30	2.70	0.05
Tracer	186.48	171	210	10.00	39.00	538.00	2.10	535.90	10.00

### Analysis Results

<b>Peak</b>	<b>Nuclide</b>	<b>Energy (keV)</b>	<b>Width (keV)</b>	<b>Aliquot pCi</b>	<b>MDA pCi</b>	<b>% Error</b>
1	Th-230	4687.70	19.20	0.591	n/a	372.25 %
2	Th-232	4013.00	0.00	-0.084	n/a	-107.35 %
3	Th-228	5430.00	19.02	0.840	n/a	261.99 %
4	Th-227	6038.21	18.86	0.756	n/a	182.16 %
Tracer	Th-229	4845.00	95.80	150.128	n/a	8.45 %

### Totals

% Total

Gross Count:	725.00	100.00
Net Area:	652.10	89.94
Background:	72.90	10.06
Composite Fit:	575.00	79.31
Residuals:	150.00	20.69

000035

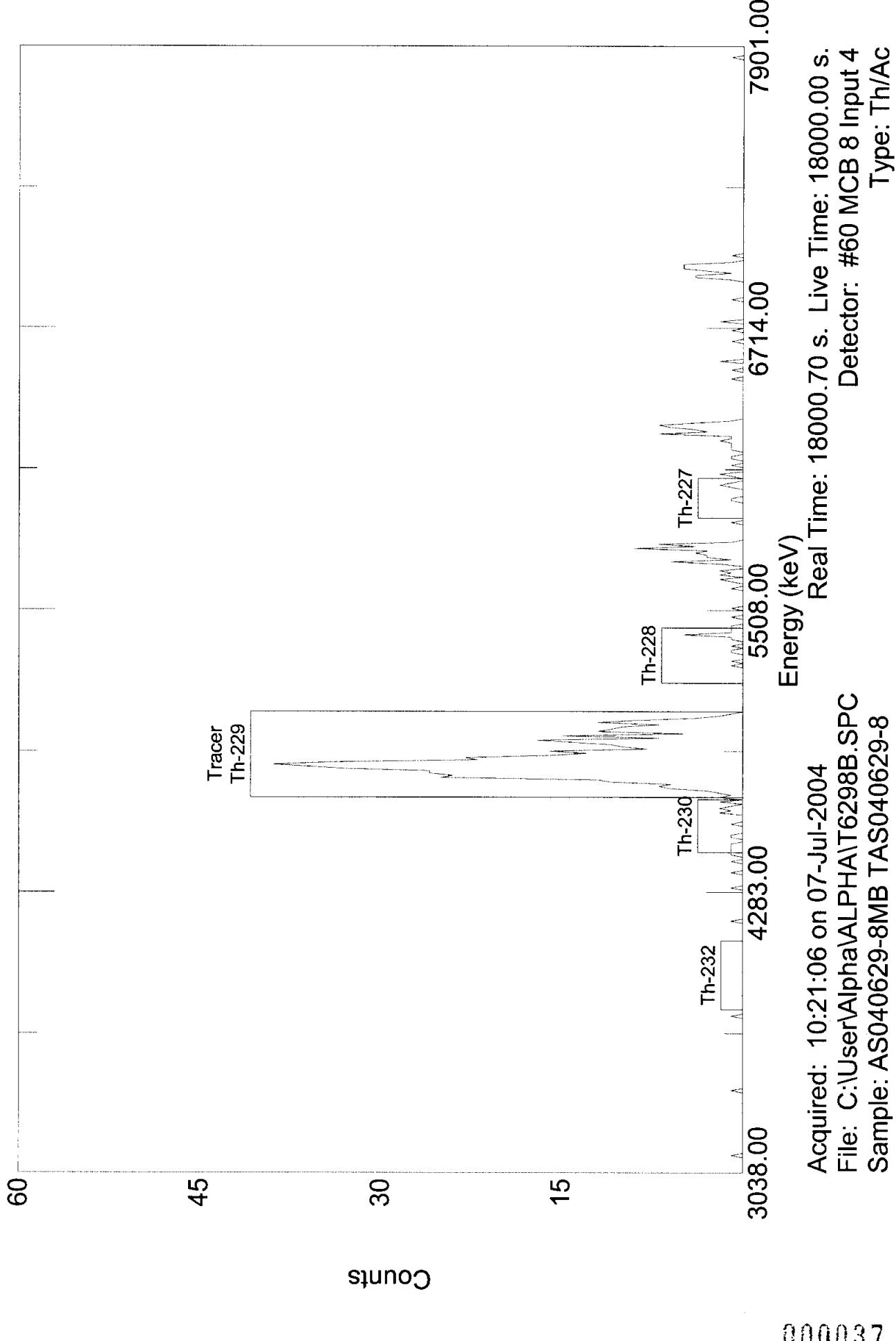
Analyzed By: *Sm*

Checked By: *JP*

000036

T6298B

AlphaVision Relative Region-Of-Interest (Slope Recalibration)



# Paragon Analytics

## Alpha Spectroscopy Analysis

Report Printed:  
7/23/04 2:41:52 PM  
*Para0327.rpt*  
rev 11/13/03 KVG

**Sample Name:** AS040629-8LCS TAS040629-8

**Analysis Type:** Th/Ac

**Detector:** MCB 8 Input 5

**Date/Time of Count:** 7/7/04 10:21:34 AM

**Sample Volume:** 0.030 Total, 0.030 Aliquot.

**Live Time:** 300.00 Minutes

**Chem. Yield:** 79.73%

**Real Time:** 300.01 Minutes

**Total Eff.:** 24.03 %

**Dead Time:** 0.0 %

**Tracer Amount:** 9.999 DPM, With Contaminant

**Acquisition:** 512 Channels

**Efficiency:** 30.14%

**Analysis:** Relative Region-Of-Interest

**Original:** 3,070 + 9.8188 \* Chn + -0.00041 \* Chn \*\*2.

**Spectrum Calibration:** 3,070 + 9.8023 \* Chn + -0.00041 \* Chn \*\*2.

**Cal File:**

**Spectrum File:** C:\User\Alpha\ALPHA\T6298L.SPC

**Background File:** C:\User\Alpha\ALPHA\B4070661.SPC

**Library File:** C:\User\Alpha\ALPHAVIS.ALB

### Peaks

<b>Peak</b>	<b>Channel</b>	<b>Start</b>	<b>End</b>	<b>FWHM</b>	<b>Height</b>	<b>Gross Cts</b>	<b>Bkg Cts</b>	<b>Net Area</b>	<b>DPM</b>
1	166.21	144	169	4.00	97.00	779.00	0.60	760.52	10.55
2	96.60	72	103	2.00	1.00	3.00	0.60	2.40	0.03
3	243.27	221	246	2.00	2.00	17.00	20.10	-3.10	-0.04
4	306.79	293	311	2.00	2.00	9.00	4.20	4.80	0.07
Tracer	182.49	170	206	12.00	62.00	722.00	1.20	720.80	10.00

### Analysis Results

<b>Peak</b>	<b>Nuclide</b>	<b>Energy (keV)</b>	<b>Width (keV)</b>	<b>Aliquot pCi</b>	<b>MDA pCi</b>	<b>% Error</b>
1	Th-230	4687.70	38.66	158.401	n/a	7.19 %
2	Th-232	4013.00	19.44	0.500	n/a	142.72 %
3	Th-228	5430.00	19.20	-0.646	n/a	-274.21 %
4	Th-227	6038.21	19.10	1.000	n/a	125.05 %
Tracer	Th-229	4845.00	115.81	150.128	n/a	7.29 %

### Totals

**% Total**

Gross Count:	1,784.00	100.00
Net Area:	1,673.90	93.83
Background:	110.10	6.17
Composite Fit:	1,530.00	85.76
Residuals:	254.00	14.24

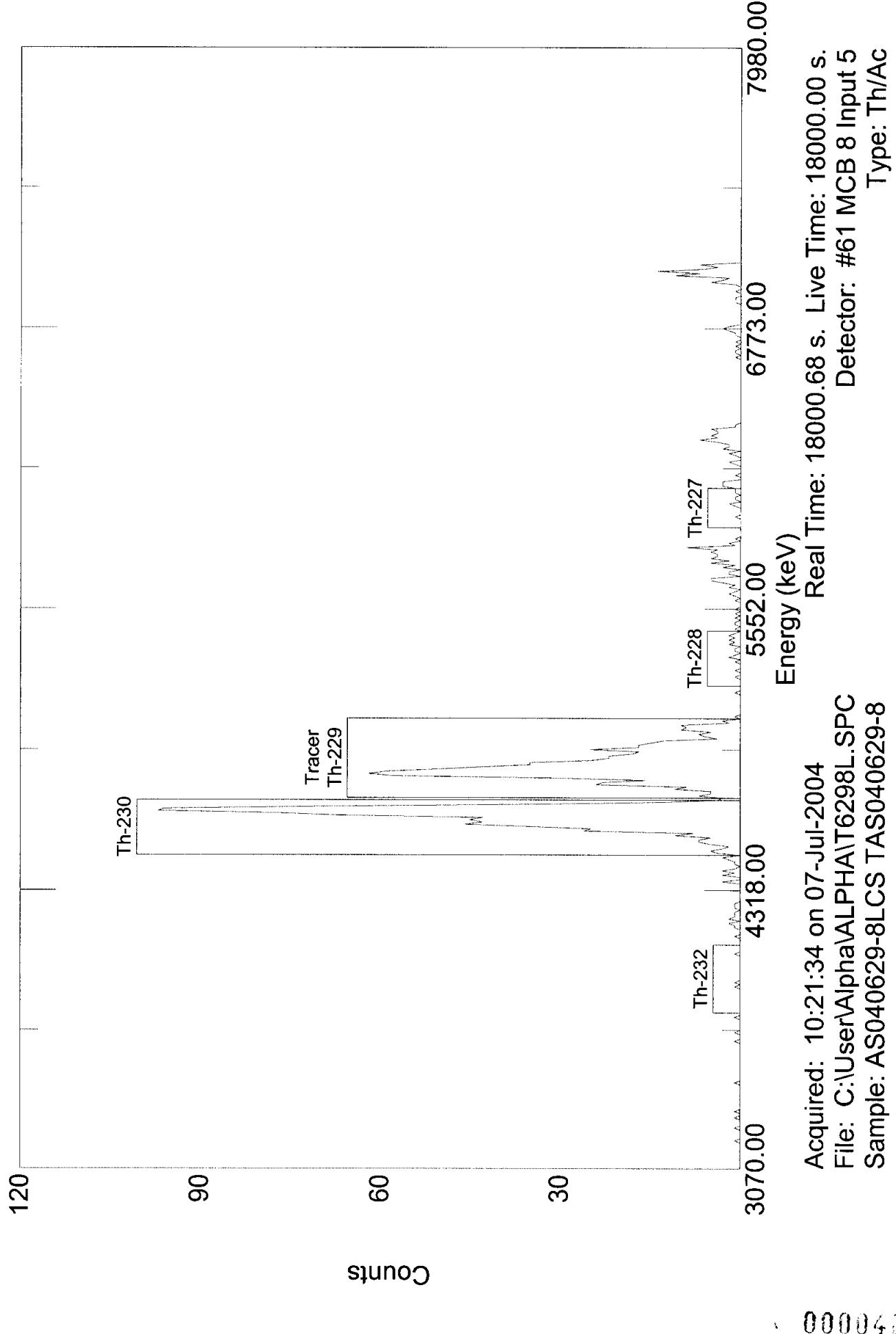
000038

Analyzed By: *SM*

Checked By: *JP*

T6298L

AlphaVision Relative Region-Of-Interest (Slope Recalibration)



**Paragon Analytics**  
**FORM 746f.xls (11/8/2000)**  
**L79210 Alpha Spectrometer Instrument Run Log**

Date: 7/7/04

Detector	Batch ID	Sample ID	Iso/Matrix	Duration	Initial	File ID/Comm.
44	276533	0418033-1	Pu/V	300	SD	0180331
50		2			2	1
51		3			11	3
52	↓	4	↓	↓	4	12
53	15040624-1	0406089-4	Np/L	1000	NR60894	13
54	1	4D			4D	15
55		5			5	16
56		6		↓	6	17
25	04060917-3				NR609173	18
26		3D			3D	19
27		4			4	21
28		5		↓	5	22
29	↓	AS0406241MB	↓	↓	NR6241B	23
30	15040621-1	0405254-31	Am/F		AR5CSY31	24
31	↓	15040621-1MMB	+	↓	AC211mB	42
32	15040623-1	0405054-3			ASD543	43
33		4			44	2
34		7			45	THS
35		9			46	3
37		10			47	17
38		11 SD			48	18
36	↓	AS040623-15 <sup>ML</sup>		↓	AS23-ML	57
39	↓	AS040623-6 PLL		↓	PL	58
43	AS040624-9	0406099-7D	This	300	SD	TR60997D

Notes: control on 27 9 2011

Reviewed by:	Jm
Date:	7-8-04

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# Paragon Analytics

## Alpha Spectrometer Instrument Run Log

FORM 746r.xls (11/8/2000)

7/17/01

Date: 7/17/01

Detector	Batch ID	Sample ID	Iso/Matrix	Duration	Initial	File ID/Comm.	Detector	Batch ID	Sample ID	Iso/Matrix	Duration	Initial	File ID/Comm.
60	ASO10629-8	ASO10629-8M3	M1S	300	4D	T6298B	44	ASO10629-7	ASO10629-4	T62984	1000	SD	T62984
41	↓	↓	CCS	↑	↑		45	↓	04060629-3	L	↑	↓	TR60629-3
42	ASO10629-1	ASO10629-1	U1S				46	ASO10629-5	0404291-2	U1S	300	1	UX42912
43			2				47			2M5			2M
44		3	↓				48			2MSD			UX13142
45		4	↓				57			0404314-2			
46	ASO10629-2	C4062911-1	Pu1S	300	SD	P6111	58		2M5				2M
50			1D				59			ZA1SD			UX50504
51			2				60			0405050-4			
52		3	↓				61			4MS			4M1
49	ASO10629-12	ASO10629-12M3	U1S	300	SD	U1R6232B	62		4MSD				4M
50	ASO10629-1	ASO10629-4	U1S				63			ASO10629-5M3			UX6295B
51			4D				64			↑ CCS			↑ L
52			5				5						
53			6				6						
54			7				7						
55			8				8						
56			9				9						
57			10				10						
58			11				11						
59			12				12						
60			13				13						
61			14				14			U62913			SD7305
62			15				15			↑ L			
63			16				16						
64			17				17						
65			18				18						
66			19				19						
67			20				20						
68			21				21						
69			22				22						
70			23				23						
71			24				24						

Notes:

Completed from 274210

Reviewed by: QD
Date: 7/18/01

000347

**PARAGON ANALYTICS**  
**Radiochemistry Data Package**

Section 5

**QUALITY ASSURANCE**  
**SUMMARY REPORTS**

**5**

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*Paragon Analytics*

QUALITY ASSURANCE SUMMARY SHEET

277615

PAI W.O. # / BATCH 0405097/GS040611-1

TEST X

METHOD prep

SOP/REV (PREP) 739-8

SOP/REV (ANAL)

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

The samples were digested per SOP 739-8 without the addition of boric acid in step 8.3.10 to prevent interferences with any other tests (such as Pb-210). The samples were brought to 1L with DI water and packed as a 3oz. l. After gamma analysis the samples will be used to a liquor for other analyses.

TECHNICIAN/ANALYST

*Chad Daigle*

DATE 6/16/04

DEPARTMENT MANAGER

*Choncarage*

DATE 6/16/04

*Paragon Analytics*

**QUALITY ASSURANCE SUMMARY SHEET**

**277627**

PAI W.O. # / BATCH 0405097/AS040629-7,8  
TEST U-ISO Th-ISO  
METHOD Prep  
SOP/REV (PREP) 7/8/9, 7/7/0  
SOP/REV (ANAL) \_\_\_\_\_

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

*10 7/3/04*

The following applies to batches AS040629-7 and AS040629-8 for the analysis of Th-ISO and U-ISO.

1. Aliquots for the samples were taken from gamma fraction digestates (See QASS 277615). Aliquot sizes from the digestates were determined by the activity seen in the gamma analysis data. Actual aliquot sizes were entered onto the benchsheet using the following equation:

$$\text{Sample Size (x)} = \frac{(\text{Original Sample weight}) * (\text{Digestate taken for analysis})}{(\text{Total volume of digestate})}$$

2. A consistent 20-25 mL of ammonium hydroxide was used per sample in order to form the ferric hydroxide precipitate prior to running a chloride column.

*10 7/3/04*

TECHNICIAN/ANALYST

DEPARTMENT MANAGER

*Zo Elhart*

*Zo Palmer*

DATE 7/3/04

DATE 7/3/04

**PARAGON ANALYTICS**  
**Radiochemistry Data Package**

**Section 6**

**LABORATORY  
BENCH SHEETS**

**6**

000046

## Paragon Analytics

## Radiochemistry Instrument Worksheet

Prep Batch: AS040629-8

### Prep Procedure: Th/Ac

### QC / Init Alq / Fin Alq

### Units

### Cnt 1 File

### Cnt 1 Pos

### Chk By

### Cnt 2 File

### Cnt 2 Pos

### Chk By

### Cnt 3 File

### Cnt 3 Pos

### Chk By

### Inst/Det

### Cnt 1 Inst/Det

### Cnt 2 Inst/Det

### Cnt 3 Inst/Det

### Notes

Analytical QASS / NCR? Y / (N)  A

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Cnt 1 File	Cnt 1 Pos	Chk By	Cnt 2 File	Cnt 2 Pos	Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Chk By	Notes
1	0405097-19	SMP	0.010123	0.010123	g	_509719	21	SD	_509719			_509719			
1	0405097-19	DUP	0.010123	0.010123	g	_509719D	22		_509719D			_509719D			
1	0405097-21	SMP	0.014525	0.014525	g	_509721	23		_509721			_509721			
1	0405097-23	SMP	0.067036	0.067036	g	_509723	24		_509723			_509723			
1	0405097-28	SMP	0.016298	0.016298	g	_509728	42		_509728			_509728			
1	AS040629-8	MB	0.03	0.03	g	_6298B	60		_6298B			_6298B			
1	AS040629-8	LCS	0.03	0.03	g	_6298L	61		_6298L			_6298L			

### Direct Carrier Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aldquot	Units	Pipet ID
T1	TH-229	630.2613.45	19.997	DPM/ml	06/30/04	0.5	ml	AW004

### Spiked Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aldquot	Units	Pipet ID
S1	TH-230	581.2382.60	20.003	DPM/ml	06/30/04	0.5	ml	AW004

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## Paragon Analytics

## Radiochemistry Prep Worksheet

Prep Batch: AS040629-8

Prep Procedure: Th/Ac

Reviewed By: CRW ( w ) Review Date: 7/23/04

Non-Routine Pre-Treatment? Y / N Batch: \_\_\_\_\_

Prep SOP: PAI 777 Rev: 7

Prep SOP: NONE

Matrix Class: solid

Re-Prep? Y / N

Batch: \_\_\_\_\_

Prep QASS / NCR? Y / N

Prep Analyst: Tambrae Elhart  
Prep Date: 6/30/04  
Prep Dept: AP

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq g	Fin Aliq g	Prep Basis	Total Digestate Vol(ml)	Digestate Vol Taken(ml)	Decay Date/Time	Micro Init	Standards	Prep Notes
1	1	0405097-19	SMP	0.010123	0.010123	Dry Weight	1000	7	06/30/04 13:47		T1		
2	1	0405097-19	DUP	0.010123	0.010123	Dry Weight	1000	7	06/30/04 13:47		T1		
3	1	0405097-21	SMP	0.014525	0.014525	Dry Weight	1000	14	06/30/04 13:47		T1		
4	1	0405097-23	SMP	0.067036	0.067036	Dry Weight	1000	58	06/30/04 13:47		T1		
5	1	0405097-28	SMP	0.018298	0.018298	Dry Weight	1000	12	06/30/04 13:47		T1		
6	1	AS040629-8	MB	0.03	0.03	Dry Weight	1000	30	06/30/04 13:47		T1		
7	1	AS040629-8	LCS	0.03	0.03	Dry Weight	1000	30	06/30/04 13:47		S1,T1		

Spiked By: Tambrae Elhart Date: 6/30/04

Witnessed By: Grace Campagnola Date: 6/30/04

Reviewed By: CRW ( w ) Review Date: 7/23/04

Tracer/Carrier Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Prep Date	Aliquot	Units	Pipet ID
T1	TH-229	630.2613.45	19.997	DPM/ml	06/30/04	0.5	ml	06/30/04	0.5	ml	AW004

Spiked/Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Prep Date	Aliquot	Units	Pipet ID
S1	TH-230	581.2382.60	20.003	DPM/ml	06/30/04	0.5	ml	06/30/04	0.5	ml	AW004

Relinquished By: See \_\_\_\_\_

Date: Previous Page

Received By: \_\_\_\_\_

Date: \_\_\_\_\_

Comments \_\_\_\_\_

## Paragon Analytics

## Radiochemistry Instrument Worksheet

Prep Batch: AS040629-8

### Prep Procedure: Th/AC

Analytical QASS / NCR? Y <input checked="" type="checkbox"/> N <input type="checkbox"/>														
Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Cnt 1 File	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
1	0405097-19	SMP	0.010123	0.010123	g	TA	509719	2.1	509719	509719D	509719	509719	509719D	
1	0405097-21	SMP	0.014525	0.014525	g		509721	2.3		509721			509721	
1	0405097-23	SMP	0.067036	0.067036	g		509723	2.4		509723			509723	
1	0405097-28	SMP	0.018298	0.018298	g		509728	4.2		509728			509728	

### Tracer/Carrier Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
T1	TH-229	630.2813.45	19.997	DPM/ml	08/30/04	0.5	ml	AW004

### Spiked Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	TH-230	581.2382.60	20.003	DPM/ml	08/30/04	0.5	ml	AW004

00000000

**Paragon Analytics****Radiochemistry Prep Worksheet**

Prep Batch: AS040629-8

Prep Procedure: Th/AC

Reviewed By: tde 7/30/04

Review Date: 7/3/04

Non-Routine Pre-Treatment?  N Batch: See QASS 207765 Re-Prep? Y /  N

Prep SOP: PAI 777 Rev: 7

Prep SOP: NONE

Matrix Class: solid

Reviewed By: tde 7/30/04

Review Date: 7/3/04

Prep Analyst: Tamrae Elhart 7/30/04

Prep Date: 6/30/04

Prep Dept: AP

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Total Digestate Vol(ml)	Digestate Vol Taken(ml)	Decay Date/Time	Micro Init	Micro Date	Standards	Prep Notes
1	1	0405097-19	SMP	0.010123	0.010123	Dry Weight	1000	7	7/1/04@000	7/3/04	T1			
2	1	0405097-19	DUP	0.010123	0.010123	Dry Weight	1000	7			T1			7/3/04
3	1	0405097-21	SMP	0.014625	0.014625	Dry Weight	1000	14			T1			7/3/04
4	1	0405097-23	SMP	0.067036	0.067036	Dry Weight	1000	58			T1			7/3/04
5	1	0405097-28	SMP	0.018298	0.018298	Dry Weight	1000	12			T1			7/3/04

Spiked By: Tamrae Elhart Date: 6/30/04

Witnessed By: Grace Campagnola Date: 6/30/04

**Tracer/Carrier Solution Information**

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot Units	Pipet ID
T1	TH-229	630.2613.45	19.997	DPM/ml	06/30/04	0.5 ml	AW004

Reviewed By: tde 7/30/04

Review Date: 7/3/04

Batch: A/A

Review Date: 7/3/04

Prep QASS / NCRT(Y / N 207765\_207762)

Received By: jm

Date: 7/30/04

Batch: Balance: 10

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

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Review Date: 7/3/04

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Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

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Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

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Review Date: 7/3/04

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Date: 7/30/04

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Review Date: 7/3/04

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Review Date: 7/3/04

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Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

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Batch: Balance:

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Batch: Balance:

Review Date: 7/3/04

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Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

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Received By: jm

Date: 7/30/04

Batch: Balance:

Review Date: 7/3/04

Received By: jm

**Paragon Analytics****Radiochemistry Prep Worksheet**

Prep Batch: AS040629-8

**Prep Procedure:** Th/Ac**Prep Batch Not Validated!!!**

Reviewed By:

Batch: \_\_\_\_\_

Re-Prep? Y / N

Batch: \_\_\_\_\_

Prep QASS / NCR? Y / N

Prep SOP: PAI 777 Rev: 7

Prep SOP: NONE

Matrix Class: solid

Non-Routine Pre-Treatment? Y / N

Batch: \_\_\_\_\_

Re-Prep? Y / N

Batch: \_\_\_\_\_

Prep QASS / NCR? Y / N

Review Date:

Prep Analyst: Tambrae Elhart 10

Prep Date: 06/30/04 6/30/04

Prep Dept: AP

Samp Num	Prep Num	LabID	QC	Dish Type	No.	Init Aq g	Fin Aq g	Prep Basis	Total Digestate Vol(ml)	Digestate Vol Taken(ml)	Decay Date/Time	Micro Init	Micro Date	Standards	Prep Notes
3	1	0405097-19	SMP	0.010123	0.010123	As Received	1000	7	7/1/04 10:00			T1			
3	2	0405097-19	DUP	0.010123	0.010123	As Received	1000	7				T1			
3	1	0405097-21	SMP	0.014525	0.014525	As Received	1000	14				T1			
4	1	0405097-23	SMP	0.067036	0.067036	As Received	1000	58				T1			
5	1	0405097-28	SMP	0.018298	0.018298	As Received	1000	12				T1			
2	1														

Spiked By: Tambrae Elhart 10

Date: 6/30/04 6/30/04

Witnessed By: XC

Date: 6/30/04

Relinquished By: \_\_\_\_\_

Date: \_\_\_\_\_

**Tracer/Carrier Solution Information**

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
T1	TH-229	630.2613.45	19.997	DPM/ml	06/29/04	0.5	ml	AW004

Re-Prep? Y / N

Batch: \_\_\_\_\_

Prep QASS / NCR? Y / N

Review Date:

Balance: 10

Balance: \_\_\_\_\_

Prep Notes

Prep Analyst: Tambrae Elhart 10

Prep Date: 06/30/04 6/30/04

Prep Dept: AP

Review Date:

Balance: \_\_\_\_\_

Prep Notes

Prep Analyst: Tambrae Elhart 10

Prep Date: 06/30/04 6/30/04

Prep Dept: AP

Review Date:

Balance: \_\_\_\_\_

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Prep Analyst: Tambrae Elhart 10

Prep Date: 06/30/04 6/30/04

Prep Dept: AP

Review Date:

Balance: \_\_\_\_\_

Prep Notes

## SAMPLE CONDITION FORM (SOLIDS)

ANALYST: TE

**ANALYSIS DATE:** 6/29/04

METHOD: prep

000052

Paragon Analytics, Inc.

261114

Sample Digestions Worksheet

Paragon Sample ID	Original sample weight (g)	As Rec'd / Dry Wt (g)	Total % moist	Sample Matrix	Digest* Solution Nature	digestate size taken for analysis (ml)								
						Pu	U	Th	Am/Cm	Np	Fe-55	Pu-241	Sr	a/b
1505097-2	.881	Dry wt	1000	NA soil	Nitric	160	110							
2-D	881				DI H2O	160								
3	9452													
17	1.371													
19	1.4461													
19-D	1.4461													
21	1.0375													
22	1.5337													
23	1.1558													
23-D	1.1558													
24	1.9311													
25	1.4498													
28	1.5248													
29	1.3546													
29-D	1.3546													
30	1.1863													
MB	1.0000													
LCS	1.0000													

Prep Analyst  
Prep Date  
Balance No.  
QASS#  
SOP/REV

7/1  
6/30/04  
10A

\* Digest solution nature = The name of digestate media (e.g., 8N HNO3)

Reviewed by

Date

7/3/04

000053

**PARAGON ANALYTICS**  
**Radiochemistry Data Package**

**Section 7**

**STANDARDS  
TRACEABILITY  
DOCUMENTS**

**7**

PROJECT Th-229 630.2613.45

Notebook No. 2613

45

Continued From Page

Th-229

Prepare a working level dilution of Th-229 (630.2382.28) at 20.00 dpm/mL by diluting with 0.5 M HNO<sub>3</sub> → Lot # 43059

1) Determine the density of 0.5 M HNO<sub>3</sub>

Mass of empty 100 mL Class A volumetric flask

68.3266 g (bal 12)

Mass of flask + 100 mL of 0.5 M HNO<sub>3</sub>

169.4627 g

Net mass of 0.5 M HNO<sub>3</sub>

101.1361 g

$$\rho = .0114 \text{ g/mL}$$

2) Add / transfer approx 10.0 g of Th-229 (630.2382.28)

to a 1 L nalgene bottle

Mass of empty nalgene bottle without lid (bal 12) 74.1499 g

Mass of nalgene bottle + standard

84.3850 g

Net mass of standard transferred

10.2351 g

3) Dilute to final volume with 1.0 M HNO<sub>3</sub>

Mass of empty nalgene bottle w/out lid (from above)

74.1499 g

Mass of bottle, standard + 1.0 M HNO<sub>3</sub>

92.667 g (bal 12)

Net mass of standard

852.5501 g

4) Final Activity Calculation

$$\frac{(1647.2 \text{ dpm/g})(10.2351 \text{ g})}{852.5501 \text{ g}} = 20.00 \text{ dpm/mL}$$

Sind ID: 630.2613.45

Description: Th-229

Expiration: 5/10/2005

Activity: 20.00

dpm/mL

2s Uncertainty: 2.33

dpm/mL

Ref. Date: 7/17/2002

dpm/mL

Ref Time: N/A

dpm/mL

Prep Date: 5/2/2004

dpm/mL

Matrix/Comp: 0.5 M HNO<sub>3</sub>

dpm/mL

Half Life (y): 7.34E+03

dpm/mL

Th-228, Th-230, Th-232 impurities

Sp 5/27/04

Continued on Page

Read and Understood By

Choncavage

Signed

5/2/04

Date

Signed

5/27/04

Date

00005

Prepare a 1<sup>o</sup> dilution of Analytics 64206-307 by transferring contents of the ampule to a 40 ml ~~0.5% 8/15/02~~  
~~0.5% 8/15/02~~ VOA 250 ml Nalgene bottle & diluting to approx  
 150 mL w/ 0.5 M HNO<sub>3</sub>. (Lot # K09338301 8/13 9/16/02)

- 1) Transfer contents of ampule to 250 mL bottle

Mass of empty Nalgene bottle (% std.)	23.9862 g (Bal 12)
Mass of opened ampule + 50 mL beaker	37.8911 g
Mass of empty ampule + beaker	33.1523 g
Net mass of std. transferred	4.7388 g

- 2) Dilute std. in Nalgene bottle

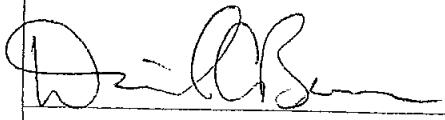
Mass of empty bottle (from above)	23.9862 g
Mass of bottle + std. + 0.5 M HNO <sub>3</sub>	170.5635 g (Bal 12)
Net mass of std.	146.5773 g

- 3) Final Activity Calculation

$$\left( \frac{4.258 \times 10^3 \text{ dps}}{5.01424 \text{ g}} \right) \left( \frac{4.7388 \text{ g}}{146.5773 \text{ g}} \right) (60 \text{ s/m}) = 1647.2 \text{ dps/g}$$

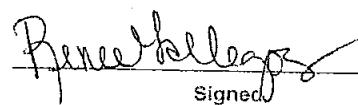
36.91610<sup>2</sup>

Read and Understood By



Signed

8/15/02  
Date



Signed

9/16/02  
Date  
00035

Continued on Page



## CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

64206-307

PAID .00630  
recd 7-19-02

Th-229 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

ISOTOPE:	Th-229
ACTIVITY (dps):	4.258 E3
HALF-LIFE:	7340 years
CALIBRATION DATE:	July 17, 2002 12:00 EST
TOTAL UNCERTAINTY*:	3.5%
SYSTEMATIC:	2.6%
RANDOM:	0.9%

\*99% confidence level.

Impurities: Th-228 26.9 dps  
Th-230 26.5 dps  
Th-232 1.8 dps

5.01424 grams 0.5M HNO<sub>3</sub> solution.

P O NUMBER 001620, Item 1

SOURCE PREPARED BY:

  
M. D. Currie, Radiochemist

Q A APPROVED:

 J. M. Ritz 7-18-02

000057

30  
PROJECT Th-230 581.2382.60

Notebook No. 2382

Continued From Page \_\_\_\_\_

Th-230

Prepare a working level dilution of Th-230 (581.1808.65) to 20 dpm/ml by diluting w/ 0.1M HNO<sub>3</sub> (Lot #42270)

1) Determine the density of 0.1M HNO<sub>3</sub>

mass of empty 100 ml volumetric flask

64.14140 g (Bal 2)

mass of flask + 0.1M HNO<sub>3</sub>

1164.5730 g ↓

net mass of 0.1M HNO<sub>3</sub>

99.959 g

$$\rho = 0.9996 \text{ g/ml}$$

2) Transfer approx 17g of Th-230 (581.1808.65) to a

1L Nalgene bottle

mass of empty 1L nalgene bottle w/o lid

74.4414 g (Bal 2)

mass of bottle + std

91.5530 g ↓

net mass of std transferred

17.116 g

3) Dilute to final volume w/ 0.1M HNO<sub>3</sub>

mass of empty 1L nalgene bottle (from above)

74.4414 g

mass of bottle + std + 0.1M HNO<sub>3</sub>

1068.5 g (Bal 2)

net mass of std

994.06 g

4) Final activity Calc

$$\frac{(1162.00 \text{ dpm/ml})(17.116 \text{ g})}{994.06 \text{ g}} = 20.00 \text{ dpm/ml}$$

Stnd ID: 581.2382.60

RG 2/11/03

Reverification of std:

50 3/5/04

Description: Th-230

Activity: 20.00 dpm/ml

Description: Th-230

Expiration: 2/10/05

dpm/mL

Activity: 20.00

2s Uncertainty: 0.43

dpm/mL

Ref. Date: 5/15/01

Ref Time: N/A

Prep Date: 1/20/03

Matrix/Comp. 0.1 M HNO<sub>3</sub>

Half Life (y): 7.54E+04

Prep by: CDM

2s Uncertainty: 0.427 ± 0.042 dpm/ml

Ref. Date: 5/15/01

Ref Time: na

Prep Date: 2/2/03 Prep by: CDM

Expiration: 2/5/04

Matrix/Comp. 0.1M HNO<sub>3</sub>

Half Life (y): 7.54E+04

RG 2/11/03

SD

3/5/04

Continued on Page

Read and Understood By

Carissa Moncavage

Signed

Date

Renell Hollings

Signed

1/30/03

Date

000053

5/10/01 Prepare a 1000 dpm/ml solution of Th-230 by diluting RSD # 581 with 0.1M HNO<sub>3</sub>

- 1) Determine density of 0.1M HNO<sub>3</sub> (6.25 mL conc. HNO<sub>3</sub> diluted to 1L with DI H<sub>2</sub>O)

Mass of 100 mL volumetric flask	64.6110 g (balance #12)
Mass of flask + 0.1M HNO <sub>3</sub>	164.5707 g
Net mass of 0.1M HNO <sub>3</sub>	99.9597 g
$D = 999.6 \text{ g/mL}$	

- 2) Directly transfer approximately 40mL to VOA vial -  
No dilution

- 3) Transfer remaining standard in ampule to 500mL poly

Mass of 500 mL poly minus lid	32.50763 g (balance #12)
Mass of 500 mL poly + Standard	43.0529 g
Mass of Standard	10.5456 g

- 4) Bring Standard to final dilution with 0.1M HNO<sub>3</sub>

Mass of empty bottle (from above)	32.5073 g (balance #12)
Mass of VOA vial + Standard + 0.1M HNO <sub>3</sub>	233.16 g (balance #24)
Net mass of std (diluted)	200.65 g Dose 500/4

- 5) Final Activity Calculation:

$$(18390 \text{ Bq}) (200 \text{ dpm/Bq}) (0.9991 \text{ g/mL}) (0.5456 \text{ g}) = 1000.03 \text{ dpm/mL}$$

$$(49.88438 \text{ g}) (233.16 \text{ g}) / 200.65 \text{ g} = 1162.06 \text{ dpm/mL}$$

Stnd ID: 581.1808.65

*5/10/01*  
 Description: Th-230  
 Activity: 1162.00 dpm/ml  
 Uncertainty: 37.000 dpm/ml  
 Ref. Date: 5/15/01  
 Ref Time: na  
*5/10/01*  
 Prep Date: 5/10/01 Prep by: RLF  
 Expiration: 5/22/03  
 Matrix/Comp. 0.1 M HNO<sub>3</sub>  
 Half Life (y): 7.54E+04

Issued on Page \_\_\_\_\_

Read and Understood By

*R. Fall*  
 Signed

5/10/01  
 Date

*D. C. S.*  
 Signed

5/10/01  
 Date

**Isotope Products  
Laboratories**

An Eckert & Ziegler Company

24937 Avenue Tibbitts  
Valencia, California 91355

Tel 661·309·1010  
Fax 661·257·8303

PAT ID 00581  
Recd 5-07-01

**CERTIFICATE OF CALIBRATION  
ALPHA STANDARD SOLUTION**

Radionuclide: Th-230  
Half-life: (7.54 ± 0.03)E+04 years  
Catalog No.: 7230  
Source No.: 758-93

Customer: PARAGON ANALYTICS, INC.  
P.O. No.: 001295  
Reference Date: 15-May-01 12:00 PST  
Contained Radioactivity: 0.4969 μCi 18.39 kBq  
(Th-230 only)

**Physical Description:**

- A. Mass of solution: 49.88438 g in 50 mL flame-sealed ampoule
- B. Chemical form: Th(NO<sub>3</sub>)<sub>4</sub> in 0.1M HNO<sub>3</sub>
- C. Carrier content: 10 μg Th/mL of solution
- D. Density: 1.0016 g/mL @ 20°C.

**Radioimpurities:**

Am-241 = 0.110%; Ra-226 daughter = 0.400% on 15 May 01

Radionuclide Concentration: 0.009961 μCi/g, 0.3686 kBq/g

**Method of Calibration:**

This source was prepared from a weighed aliquot of solution whose activity in μCi/g was determined using a liquid scintillation counter.

**Uncertainty of Measurement:**

- A. Type A (random) uncertainty: ± 1.2 %
- B. Type B (systematic) uncertainty: ± 3.0 %
- C. Uncertainty in aliquot weighing: ± 0.0 %
- D. Total uncertainty at the 99% confidence level: ± 3.2 %

**Notes:**

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This solution has a working life of 5 years.

Daniel James Van Dijken  
Quality Control

26-Apr-01  
Date Signed

IPL Ref. No.:

758-93

**PARAGON ANALYTICS**  
**Radiochemistry Data Package**

**Section 8**

**CHAIN OF CUSTODY**

**8**

000061

# Paragon Analytics

## Sample Number(s) Cross-Reference Table

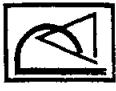
---

**Paragon OrderNum:** 0405097  
**Client Name:** Kent & Sullivan Inc.  
**Client Project Name:** Ross Adams  
**Client Project Number:**  
**Client PO Number:**

---

Client Sample	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
HR-01	0405097-1		SOLID	06-May-04	19:00
MR-01	0405097-2		SOLID	07-May-04	13:30
MR-02	0405097-3		SOLID	07-May-04	13:20
GR-01	0405097-4		SOLID	07-May-04	13:11
GR-02	0405097-5		SOLID	07-May-04	13:38
GR-03	0405097-6		SOLID	07-May-04	14:00
GR-04	0405097-7		SOLID	07-May-04	14:20
GR-05	0405097-8		SOLID	07-May-04	14:38
GR-06	0405097-9		SOLID	07-May-04	14:58
GR-07	0405097-10		SOLID	07-May-04	15:10
GR-08	0405097-11		SOLID	07-May-04	15:10
GR-09	0405097-12		SOLID	07-May-04	15:20
GR-10	0405097-13		SOLID	07-May-04	15:35
QM-01	0405097-14		SOLID	03-May-04	13:40
QM-02	0405097-15		SOLID	03-May-04	14:00
QM-03	0405097-16		SOLID	03-May-04	14:20
300-01	0405097-17		SOLID	04-May-04	9:50
300-02	0405097-18		SOLID	07-May-04	16:30
700-01	0405097-19		SOLID	07-May-04	17:00
700-02	0405097-20		SOLID	07-May-04	17:30
700-03	0405097-21		SOLID	07-May-04	17:20
700-04	0405097-22		SOLID	07-May-04	18:00
900-01	0405097-23		SOLID	07-May-04	13:00
900-02	0405097-24		SOLID	07-May-04	12:10
900-03	0405097-25		SOLID	07-May-04	12:30
900-04	0405097-26		SOLID	07-May-04	19:00
900-05	0405097-27		SOLID	07-May-04	18:40
OSA-01	0405097-28		SOLID	06-May-04	14:00
OSA-02	0405097-29		SOLID	06-May-04	19:00
OSA-03	0405097-30		SOLID	06-May-04	17:00

---



# Paragon Analytics, Inc.

225 Commerce Drive Fort Collins, CO 80524  
800-443-1511 or (970) 490-1511 (970) 490-1522 Fax

Accession Number (LAB ID) 0405097 Date \_\_\_\_\_ Page 5 of 9

## Chain-of-Custody

Sampler(s):		(circle one) Turnaround: Standard or Rush (Due _____)			Dispose or Return to Client	
Project Name / No.:	Report To:	Date	Time *	Lab ID	Matrix	No. of Contaminers
circle method or specify under comments						
		2024				
SOIL-01	(X)	5-6	1600	Soil	3	
SOIL-02		5-6	1540	Soil	3	
SOIL-04		5-6	1504	Soil	3	
SOIL-05		5-6	1510	Soil	3	
SOIL-07		5-7	1350	Soil	3	
SOIL-08		5-7	1615	Soil	3	
SOIL-09		5-7	1410	Soil	3	
SOIL-10		5-7	1640	Soil	3	
HR-01		5-6	1900	1 HRK	1	
Comments: <u>(X) On 06/05/2016 by M. J. Hiltz</u>						

(1) Received By:	
Signature	Printed Name
<i>John Wachick</i>	Gerald Wachick
Date <u>5/11/14</u>	Time <u>14:45</u>
Company <u>Kent + Sullivans</u>	Company <u>Paragon Analytics</u>
(2) Relinquished By:	
Signature	Printed Name
<i>John Wachick</i>	Gerald Wachick
Date <u>5/11/14</u>	Time <u>14:45</u>
Company <u>Kent + Sullivans</u>	Company <u>Paragon Analytics</u>

Form 2024-XIS (1/3/01)

Distribution: white / yellow (Paragon); pink retained by originator.

\* Time Zone (circle one): EST CST MST PST

\*\* Indicate specific analytes under comments.



Paragon Analytics, Inc.

225 Commerce Drive Fort Collins, CO 80524  
800-443-1511 or (970) 490-1511 (970) 490-1522 Fax

Accession Number (LAB ID) \_\_\_\_\_ Date \_\_\_\_\_ Page 6 of 9  
Chain-of-Custody

Project Name / No.:	Sampler(s):	(circle one) Turnaround: Standard or Rush (Due _____)				Dispose or Return to Client
		Date	Time *	Lab ID	Matrix	
circle method(s) or specify under comments						
Sample ID	Date	Time *	Lab ID	Matrix	No. of Contaminants	
GR-01	5-7	1330	2	RK	3	
GR-02	5-7	1320	3	RK	3	
GR-03						
GR-04						
GR-05						
GR-06						
GR-07						
Comments: _____						

(1) Received By:	
Signature	Printed Name
<i>Craig Lusk</i>	Lusk
Date <u>5/10/04</u>	Time <u>10:00</u>
Company <u>Kent &amp; Sullivans</u>	Company
(2) Relinquished By:	
Signature	Printed Name
<i>John J. Wenzel</i>	Wenzel
Date <u>5/10/04</u>	Time <u>10:00</u>
Company <u>Paragon Analytics</u>	Company





## Paragon Analytics, Inc.

225 Commerce Drive Fort Collins, CO 80524  
800-443-1511 or (970) 490-1511 (970) 490-1522 Fax

## Chain-of-Custody

Accession Number (LAB ID)

Page 9 of 9

Project Name / No.:	Sample(s):	(circle one) Turnaround: Standard or Rush (Due Date _____)			Dispose or Return to Client
		Standard	Rush	Date _____	
Report To:					
Phone:					
Fax:					
Company:					
Address:					
circle method or specify under comments					
Sample ID	Date	Time *	Lab ID	Matrix	No. of Containers
700-01	5-7	1700	19	RR	3
700-02	5-7	1730	20	RR	1
700-03	5-7	1720	21	RR	3
700-04	5-7	18:00	22	RR	1
900-01	5-7	1300	23	RR	3
900-02		1210	24		1
900-03		1230	25		1
900-04		1900	24		1
900-05		1840	27		1
Comments:					
(C) Hold analysis pending metal results from samples					
700-01, 700-02, 900-01, 900-04					
Acetinides by PAI SOP (circle): Pu / U / Am / Th / Cm					
Uranium by KPA (circle): D5174-91					
Tritium					
Strontium 89 SW9315 E9030 Radium 228 SW9320 E9040					
Technetium 99m SW9315 E9030 Radium 228 SW9320 E9040					
Gross Alpha / Beta SW9310 E9000					
TOX SW9020B					
TPH GRO DRG SW8015B (both)					
Oil & Grease SW9071A E413-2					
Inorganic Anions ** SW9056 E3000					
Hexavalent Chromium SW7196A Alkaline Digest Y / N					
Dissolved Metals SW6010B 7470 7471 E200 ILMO					
Total Metals SW1311 6010B 7471 E200 ILMO					
TCLP Organics SW1311 8260B 8270C 8081A 8151A					
Herbicides SW8151A E615					
OP Pesticides SW8141A E614					
PCBs SW8082 E608 E508 OLMO					
OC Pesticides SW8081A E608 E508 OLMO					
SVOCs SWB270C E625 E525 OLMO					
BTEX (only) SW8021B					
VOCs SW8260B E624 E524 OLMO					
No. of Containers					
Matrix					
Lab ID					
Date					
Time *					
Signature _____					
Printed Name _____					
Date _____ Time _____					
Company _____					
(1) Received By:					
Signature _____					
Printed Name _____					
Date _____ Time _____					
Company _____					
(2) Received By:					
Signature _____					
Printed Name _____					
Date _____ Time _____					
Company _____					

Distribution: white / yellow (Paragon); pink retained by originator.

Form 2024.xls (7/3/01)

\*\* indicates contains analytes under comment



Paragon Analytics, Inc.

225 Commerce Drive Fort Collins, CO 80524  
800-443-1511 or (970) 490-1511 (970) 490-1522 Fax

Chain-of-Custody

**Chain-of-Custody**

225 Commerce Drive Fort Collins, CO 80524  
800-443-1511 or (970) 490-1511 (970) 490-1522 Fax

Comments:  
H/C

ts: Hold analysis pending metal results  
OSA-01, 700-01, 700-03, and 900-01.

ham samples

**(2)**  
Relinquished By: \_\_\_\_\_  
Signature \_\_\_\_\_ Printed Name \_\_\_\_\_

Received By:	(1)	Received By:	(2)
Signature	<u>John Wolf</u>	Signature	<u>                  </u>
Printed Name	<u>John Wolf</u>	Printed Name	<u>                  </u>
Date	<u>5/14/95</u>	Date	<u>                  </u>
Company	<u>Freedom Analytic</u>	Company	<u>                  </u>

## Paragon Analytics, Inc. -- Fort Collins, Colorado

## CONDITION OF SAMPLE UPON RECEIPT FORM

CLIENT: Kent + Sullivan WORKORDER NO: 0405097  
 PROJECT MANAGER: Debbie Fazio INITIALS: DW DATE: 5/12/04

1. Does this project require any special handling in addition to standard Paragon procedures?	<input checked="" type="radio"/> Yes	No	
IS PRE-SCREENING REQUIRED? (radiochemistry, DOE, etc.)		<input checked="" type="radio"/> Yes	No
2. Are custody seals on shipping containers intact? How many custody seals are provided? <u>2 each</u>	N/A	<input checked="" type="radio"/> Yes	No
3. Are the custody seals on sample containers intact?	(N/A)	Yes	No
4. Is there a Chain-of-Custody (COC) or other representative documents, letters, or shipping memos?		<input checked="" type="radio"/> Yes	No
5. Is the COC complete?	N/A	<input checked="" type="radio"/> Yes	No
Relinquished: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Analyses Requested: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			
6. Is the COC in agreement with the samples received?	N/A	<input checked="" type="radio"/> Yes	No
No. of Samples: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Sample ID's: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			
Matrix: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> No. of Containers: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			
7. Were COC (if applicable) and sample labels legible?		<input checked="" type="radio"/> Yes	No
8. Were airbills present and/or removable?	N/A	<input checked="" type="radio"/> Yes	No
9. Are all aqueous samples requiring chemical preservation preserved correctly (excluding volatile organics)?  Are all aqueous non-preserved samples at the correct pH?	(N/A)	Yes	No
10. Is there enough sample for requested analyses? If so, were samples placed in the proper containers?		<input checked="" type="radio"/> Yes	No
11. Are all samples within holding times for the requested analyses?		<input checked="" type="radio"/> Yes	No
12. Were all sample containers received intact? (not broken or leaking, etc.)		<input checked="" type="radio"/> Yes	No
13. Are samples requiring no headspace (volatiles, reactive cyanide/sulfide, radon), headspace free? Size of bubble: <u>&lt; green pea</u> ; <u>&gt; green pea</u>  (List sample IDs and affected containers on Page 2)	(N/A)	Yes	No
14. Were samples checked for and free from the presence of residual chlorine?	(N/A)	Yes	No
15. Were the sample(s) shipped on ice?	N/A	<input checked="" type="radio"/> Yes	No
16. Were cooler temperatures measured at 0.1 - 6 °C ? IR Gun Used*: <u>D 2</u>	N/A	Yes	<input checked="" type="radio"/> No
17. Were all samples cooled that should have been cooled?	N/A	Yes	<input checked="" type="radio"/> No

Cooler #'s 924 898 897 749 868 22  
 Temperature 10° 10° 9° 15° 12° 14° °C

Project Manager Signature / Date: Debbie Fazio 5/12/04

A NO RESPONSE TO ANY QUESTION EXCEPT # 1 REQUIRES THE COMPLETION OF PAGE 2 OF THIS FORM

\* IR Gun #1 (original): Raytek, SN SC-PM3/T29403  
 IR Gun #2 (newer): Oakton, SN 2SCIR1201

## Paragon Analytics, Inc. -- Fort Collins, Colorado

## CONDITION OF SAMPLE UPON RECEIPT FORM

CLIENT: Kent + Sullivan WORKORDER NO: 0405097  
 PROJECT MANAGER: Debbie Fazio INITIALS: aw DATE: 5/12/04

- Custody seals broken (on outside of shipping container or on sample containers).
- No Chain-of-Custody (COC) present.
- Number of samples on the COC do not match the number of samples received.
- Aqueous samples not preserved correctly (see pH discussion below).
- SVOC samples contained residual chlorine (list sample IDs and affected containers below).
- Samples received at inappropriate temperature.
- Insufficient sample to perform requested analyses.
- Extraction or analytical holding times expired in transit.
- Broken/leaking bottles and intact bottles received in same cooler (list affected sample IDs below).
- No analyses requested.
- Incorrect sample type received.
- VOAs, reactive CN/S, radon not headspace free (list sample IDs and affected vials below).
- Airbills not present and/or removable (record applicable shipper's tracking number below).
- Other (describe below).

Describe discrepancy:

All samples received between 9° - 15° C. Refer to page 1 for cooler temperatures and refer to DOT Survey pages for cooler contents. Insufficient ice packed with samples.

Was the client contacted?  No;  Yes: Name Sue Kent Date/Time 5/12/04

Was the pH of any sample adjusted by the laboratory?  No;  Yes (see Table below):

NOTE: No pH adjustments shall be made without prior consent of Project Manager. After pH adjustment, hold metals and radchem samples ≥ 16 hr before analysis.

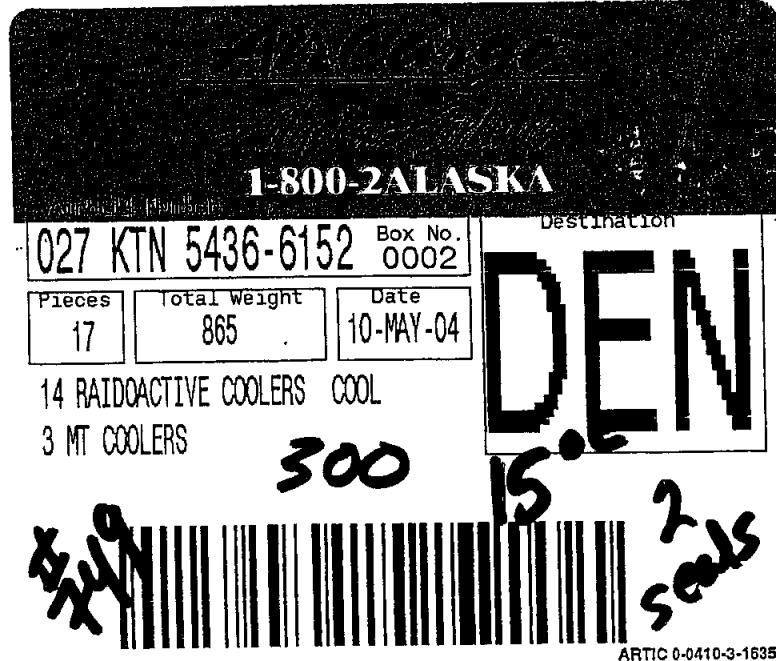
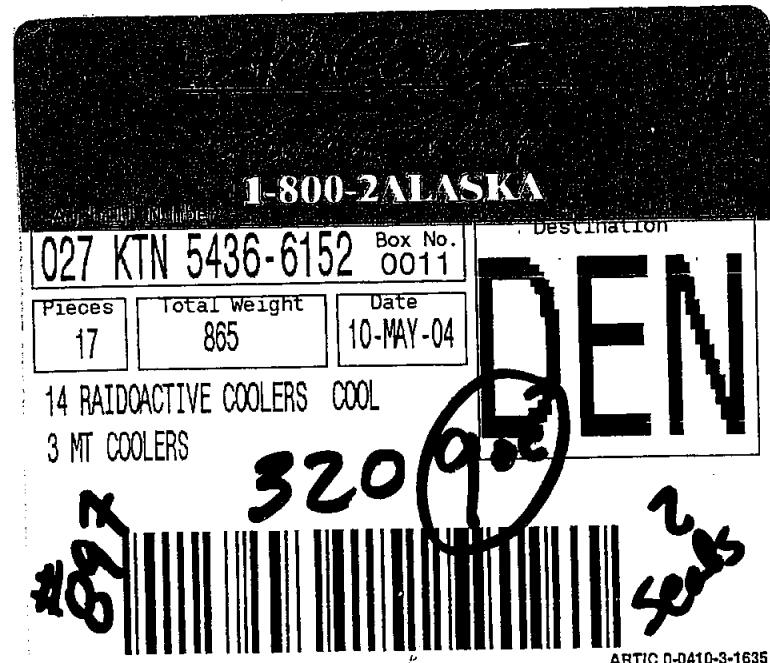
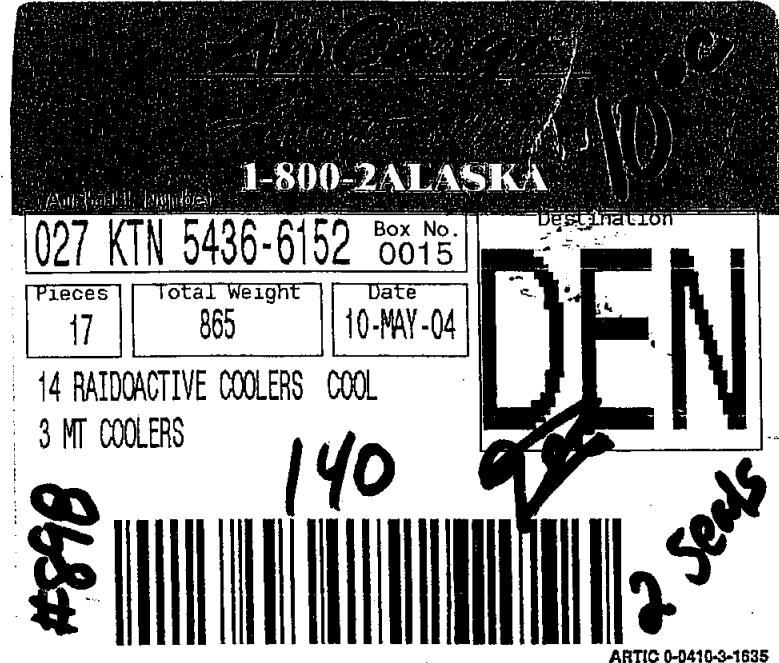
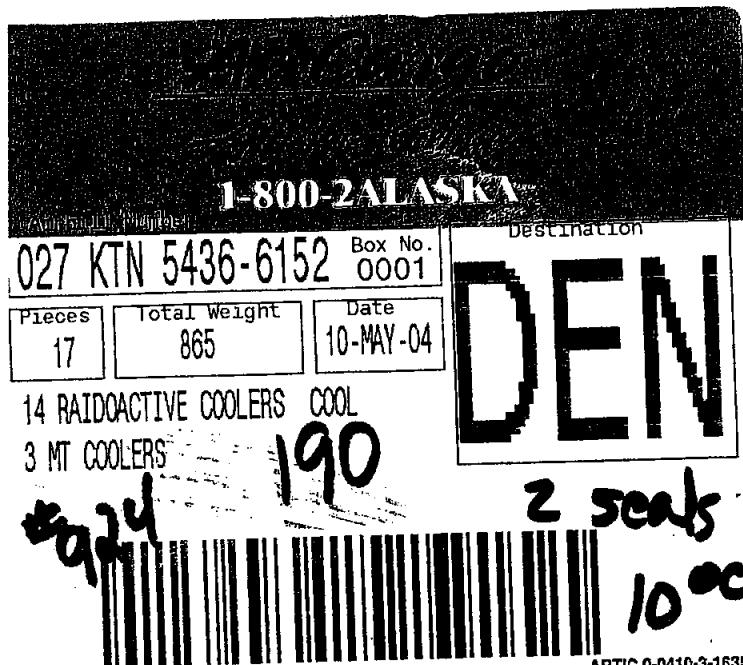
Sample ID	Initial pH	Final pH (wait 30 min)	Type of Reagent Used	Lot No. of Reagent Used	Initials / Date / Time

Was the laboratory directed to proceed with the analysis of any samples yielding the presence of residual chlorine?  No;  Yes (see notes above).

Project Manager Signature / Date: DJ 5/12/04

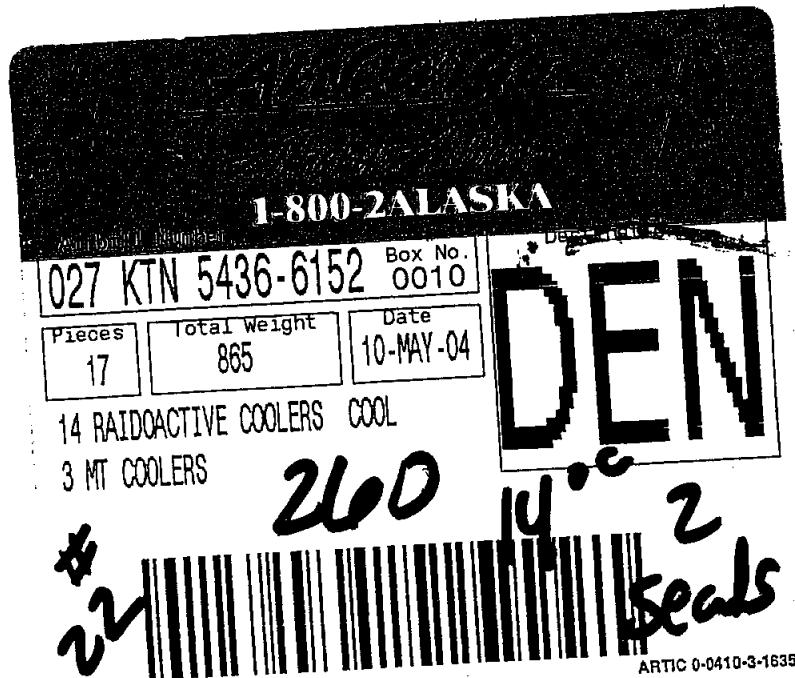
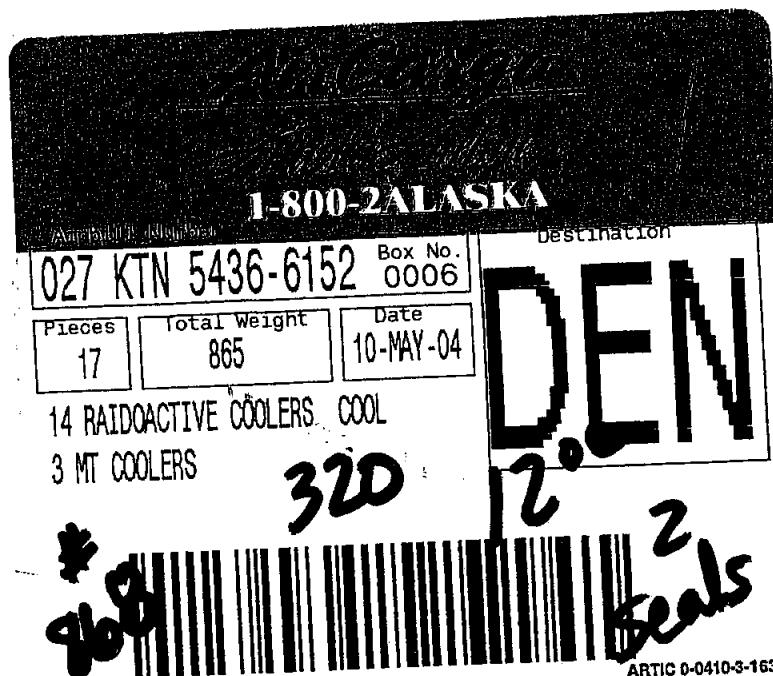
000963

0405096  
0405097



000073

0405096  
0405097



000071

## SAMPLE LOGIN / DOT SURVEY

Client: Kent & SullivanWorkorder No: 0405096 & 0405097Project Manager: Debbie FazioInitials: AW Date: 05/12/04COOLER #: 924External Micro R Meter Reading ( $\mu$  R/hr): 190

<b>Paragon Sample ID:</b>	<b>Client Sample ID:</b>	<b>Micro R Meter Reading (<math>\mu</math> R/hr):</b>
0405096-1-1	MSED-01	< background
0405096-1-2	MSED-01	< background
0405096-2-1	MSED-02	< background
0405096-2-2	MSED-02	< background
0405096-2-3	MSED-02	< background
0405096-3-1	MSED-03	< background
0405096-3-2	MSED-03	< background
0405096-3-3	MSED-03	< background
0405096-7-1	MSED-07	< background
0405096-7-2	MSED-07	< background
0405096-7-3	MSED-07	35
0405096-8-1	MSED-08	75
0405096-8-2	MSED-08	< background
0405096-8-3	MSED-08	30
0405096-9-1	MSED-09	< background
0405096-9-2	MSED-09	< background
0405096-9-3	MSED-09	150
0405096-10-1	MSED-10	> background
0405096-10-2	MSED-10	30
0405096-10-3	MSED-10	40
0405096-16-1	SSED-06	< background
0405096-16-2	SSED-06	< background
0405096-16-3	SSED-06	< background
0405097-2-1	MR-01	70
0405097-2-2	MR-01	60
0405097-2-3	MR-01	80
0405097-3-1	MR-02	85
0405097-3-2	MR-02	85
0405097-3-3	MR-02	85
0405097-17-1	300-01	800

If applicable, was the client contacted? YES / NO / NA Client Rep. Name: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Project Manager Signature/ Date: \_\_\_\_\_

## SAMPLE LOGIN / DOT SURVEY

Client: Kent & SullivanWorkorder No: 0405096 & 0405097Project Manager: Debbie FazioInitials: AWDate: 05/12/04COOLER #: 898External Micro R Meter Reading ( $\mu$  R/hr): 140

Paragon Sample ID:	Client Sample ID:	Micro R Meter Reading ( $\mu$ R/hr):
0405096-4-1	MSED-04	< background
0405096-4-2	MSED-04	< background
0405096-4-3	MSED-04	< background
0405096-11-1	SSED-01	< background
0405096-11-2	SSED-01	< background
0405096-11-3	SSED-01	< background
0405096-26-1	SOIL-02	< background
0405096-26-2	SOIL-02	< background
0405096-26-3	SOIL-02	< background
0405096-27-1	SOIL-04	< background
0405096-27-2	SOIL-04	40
0405096-27-3	SOIL-04	< background
0405096-28-1	SOIL-05	30
0405096-28-2	SOIL-05	< background
0405096-28-3	SOIL-05	< background
0405097-4-1	GR-01	< background
0405097-6-1	GR-03	< background
0405097-13-1	GR-10	< background
0405097-14-1	QM-01	< background
0405097-16-1	QM-03	< background
0405097-18-1	300-02	45
0405097-19-1	700-01	1000
0405097-19-2	700-01	950
0405097-19-3	700-01	1100

If applicable, was the client contacted? YES / NO / NA Client Rep. Name: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Project Manager Signature/ Date: \_\_\_\_\_

## SAMPLE LOGIN / DOT SURVEY

Client: Kent & SullivanWorkorder No: 0405096 & 0405097Project Manager: Debbie FazioInitials: AW Date: 05/12/04COOLER #: 897External Micro R Meter Reading ( $\mu$  R/hr): 320**Paragon Sample ID:**

0405096-5-1  
0405096-5-2  
0405096-5-3  
0405096-21-1  
0405096-21-2  
0405096-22-1  
0405096-22-2  
0405096-22-3  
0405096-22-4  
0405096-22-5  
0405096-23-1  
0405096-23-2  
0405096-24-1  
0405096-24-2

**Client Sample ID:**

MSED-05  
MSED-05  
MSED-05  
GEN-01  
GEN-01  
GEN-02  
GEN-02  
GEN-02  
GEN-02  
GEN-02  
GEN-03  
GEN-03  
GEN-04  
GEN-04

**Micro R Meter Reading ( $\mu$  R/hr):**

< background  
< background  
< background  
28  
28  
30  
29  
< background  
< background

0405097-9-1  
0405097-11-1  
0405097-15-1  
0405097-20-1  
0405097-24-1  
0405097-25-1  
0405097-27-1

GR-06  
GR-08  
QM-02  
700-02  
900-02  
900-03  
900-05

30  
< background  
< background  
250  
1500  
300  
100

If applicable, was the client contacted? YES / NO / NA Client Rep. Name: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Project Manager Signature/ Date: \_\_\_\_\_

## SAMPLE LOGIN / DOT SURVEY

Client: Kent &amp; Sullivan

Workorder No: 0405096 &amp; 0405097

Project Manager: Debbie Fazio

Initials: AW

Date: 05/12/04

COOLER #: 749

External Micro R Meter Reading ( $\mu$  R/hr): 300**Paragon Sample ID:**

0405096-6-1  
 0405096-12-1  
 0405096-12-2  
 0405096-12-3  
 0405096-18-1  
 0405096-18-2  
 0405096-18-3  
 0405096-19-1  
 0405096-19-2  
 0405096-19-3  
 0405096-25-1  
 0405096-25-2  
 0405096-25-3

**Client Sample ID:**

MSED-06  
 SSED-02  
 SSED-02  
 SSED-02  
 SSED-08  
 SSED-08  
 SSED-08  
 SSED-09  
 SSED-09  
 SSED-09  
 SOIL-01  
 SOIL-01  
 SOIL-01

**Micro R Meter Reading ( $\mu$  R/hr):**

40  
 40  
 < background  
 < background  
 < background  
 < background  
 30  
 < background  
 < background  
 < background  
 < background  
 < background  
 < background

0405097-1-1

HR-01

140

0405097-5-1

GR-02

&lt; background

0405097-7-1

GR-04

90

0405097-28-1

OSA-01

1200

0405097-28-2

OSA-01

1100

0405097-28-3

OSA-01

1200

If applicable, was the client contacted? YES / NO / NA Client Rep. Name: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Project Manager Signature/ Date: \_\_\_\_\_



## SAMPLE LOGIN / DOT SURVEY

Client: Kent & SullivanWorkorder No: 0405096 & 0405097Project Manager: Debbie FazioInitials: AW Date: 05/12/04COOLER #: 22External Micro R Meter Reading ( $\mu$  R/hr): 260**Paragon Sample ID:**

0405096-29-1  
 0405096-29-2  
 0405096-29-3  
 0405096-30-1  
 0405096-30-2  
 0405096-30-3  
 0405096-31-1  
 0405096-31-2  
 0405096-31-3  
 0405096-32-1  
 0405096-32-2  
 0405096-32-3  
 0405097-22-1  
 0405097-23-1  
 0405097-23-2  
 0405097-23-3

**Client Sample ID:**

SOIL-07  
 SOIL-07  
 SOIL-07  
 SOIL-08  
 SOIL-08  
 SOIL-08  
 SOIL-09  
 SOIL-09  
 SOIL-09  
 SOIL-10  
 SOIL-10  
 SOIL-10  
 700-04  
 900-01  
 900-01  
 900-01

**Micro R Meter Reading ( $\mu$  R/hr):**

< background  
 < background  
 < background  
 45  
 40  
 40  
 < background  
 < background  
 < background  
 55  
 50  
 65  
 450  
 110  
 110  
 140

If applicable, was the client contacted? YES / NO / NA Client Rep. Name: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Project Manager Signature/ Date: \_\_\_\_\_

**PARAGON ANALYTICS**  
**Radiochemistry Data Package**

**Section 9**

**ADDITIONAL  
SUPPORTING  
DOCUMENTATION**

**9**

000073

# Th-229 contribution to Th-230 Region-Of-Interest

Expires 3/31/05

The "Tracer Amount" field on the Thorium raw data printouts show the activity amount, and the words "With Contamination". This is not actual contamination; it is the contribution of Th-229 counts to the Th-230 ROI. Using method blank data acquired from other Thorium analyses, a calculated percentage contribution of Th-229 counts to the Th-230 ROI was established to be 2.48%, shown below. During Thorium analyses, 2.48% of the counts in the Th-229 ROI are subtracted from the Th-230 net counts and become Th-230 background counts. Therefore, on the raw data printouts, the sum of the calibrated background counts and the Th-230 net counts does not equal the Th-230 Gross Counts. Correctly calculating the Th-230 gross counts requires the sum of the calibrated Th-230 background counts, the net Th-230 counts, and the 2.48% of the Th-229 counts. Furthermore, the Th-230 total background counts used in calculations can be found on the raw data summary. Th-230 total background counts are equal to the sum of the calibrated background counts and the 2.48% of the Th-229 counts.

Sample ID	Th-230 Counts	Th-229 Counts	% Ratio
AS031203-4MB	11.400	439.400	2.59%
AS031210-4MB	32.440	1232.440	2.63%
AS031216-MMB	47.000	951.000	4.94%
AS031216-4PMB	30.000	865.000	3.47%
AS031218-2MB	19.800	537.900	3.68%
AS031218-3MMB	18.000	847.000	2.13%
AS031218-3PMB	8.000	778.000	1.03%
AS031221-2MB	14.800	574.800	2.57%
AS031222-1MB	31.000	992.800	3.12%
AS0312230-3MB	32.000	1949.000	1.64%
AS031229-2MB	34.000	1511.000	2.25%
AS040108-1MB	13.000	667.000	1.95%
AS040110-2MB	9.920	620.560	1.60%
AS040110-3MB	22.280	686.960	3.24%
AS040114-4MB	18.000	1023.000	1.76%
AS040207-2MB	17.000	906.000	1.88%
AS040111-3MB	29.000	795.020	3.65%
AS040110-3MB	17.380	964.140	1.80%
AS040325-2MB	14.740	717.960	2.05%
AS040319-3MB	18.200	943.600	1.93%
AS040319-1MB	20.320	682.220	2.98%
AS040311-3MB	27.470	972.390	2.82%
AS040312-2MB	7.400	554.400	1.33%
AS040305-3MB	23.000	707.000	3.25%
AS040302-2MB	28.580	730.220	3.91%
AS040217-2MB	12.640	806.640	1.57%
AS040210-2MB	17.400	1229.800	1.41%
AS040207-2MB	11.000	673.520	1.63%
AS040203-2MB	16.700	566.100	2.95%
AVERAGE=		2.48%	

Th-229 contribution factor updated in alphavis.alb by:

JP

Date: 3/31/04

Alpha Spectroscopy

Quality Control Data

Weekly Background, Energy, and  
Efficiency Calibrations

# Calibration Data Summary

Laboratory Name: Paragon Analytics  
 PAI Work Order: 0405097

Reported on: Monday, July 26, 2004  
 Prep SOP: PAI 777  
 Analytical SOP: PAI 714

Lab Sample ID	QC Type	Batch ID Analysis Run	Test Name	Detector Id	Eff Spectrum Bkg Spectrum Egy Spectrum	Eff Date Bkg Date Egy Date	RESULTS %Efficiency Bkg CPM Energy,keV	FLAGS Efficiency Background Energy	LCL %Efficiency Bkg CPM Energy keV	LWL %Efficiency Bkg CPM Energy keV	UWL %Efficiency Bkg CPM Energy keV	UCL %Efficiency Bkg CPM Energy keV
0405097-19	SMP	AS040629-8	Th/Ac	21	C4070621 B4070621	7/6/2004 7/7/2004	28.33 0.3930	Pass	27.83 0.0000	28.32 0.0500	30.17 0.4000	30.75 0.5000
TA509719		AS040629-8B			C4070621	7/6/2004	5546.6	Pass	5491.1	5501.1	5581.1	5591.1
7/7/2004	DUP	AS040629-8	Th/Ac	22	C4070622 B4070622	7/6/2004 7/7/2004	28.78 0.2810	Pass	27.18 0.0000	27.67 0.0500	29.47 0.4000	30.04 0.5000
0405097-19		AS040629-8B			C4070622	7/6/2004	5557.4	Pass	5503.6	5513.6	5593.6	5603.6
TA509719D		AS040629-8	Th/Ac	23	C4070623 B4070623	7/6/2004 7/7/2004	28.56 0.3170	Pass	27.21 0.0000	27.72 0.0500	29.53 0.4000	30.10 0.5000
7/7/2004	SMP	AS040629-8	Th/Ac		C4070623	7/6/2004	5548.0	Pass	5490.3	5500.3	5580.3	5590.3
0405097-21		AS040629-8B			C4070624 B4070624	7/6/2004 7/7/2004	32.35 0.3830	Pass	30.79 0.0000	31.34 0.0500	33.38 0.4000	34.03 0.5000
TA509721		AS040629-8B			C4070624	7/6/2004	5555.6	Pass	5495.6	5505.6	5585.6	5595.6
7/7/2004	SMP	AS040629-8	Th/Ac	24	C4070624 B4070624	7/6/2004 7/7/2004	31.90 0.2700	Pass	29.74 0.0000	30.28 0.0500	32.25 0.4000	32.88 0.5000
0405097-23		AS040629-8B			C4070624	7/6/2004	5561.3	Pass	5494.2	5504.2	5584.2	5594.2
TA509723		AS040629-8B			C4070642 B4070642	7/6/2004 7/7/2004	26.17 0.2430	Pass	24.46 0.0000	24.90 0.0500	26.60 0.4000	27.04 0.5000
7/7/2004	SMP	AS040629-8	Th/Ac	42	C4070642 B4070642	7/6/2004 7/7/2004	31.50 0.2700	Pass	29.74 0.0000	30.28 0.0500	32.25 0.4000	32.88 0.5000
0405097-28		AS040629-8B			C4070642	7/6/2004	5561.3	Pass	5494.2	5504.2	5584.2	5594.2
TA509728		AS040629-8B			C4070642	7/6/2004	26.17	Pass	24.46	24.90	26.60	27.04
7/7/2004	SMP	AS040629-8	Th/Ac	60	C4070650 B4070660	7/6/2004 7/7/2004	31.50 0.2430	Pass	29.74 0.0000	30.28 0.0500	32.25 0.4000	32.88 0.5000
AS040629-8	MB	AS040629-8	Th/Ac		C4070650 B4070660	7/6/2004 7/7/2004	5532.9	Pass	5489.5	5499.5	5579.5	5589.5
T6298B		AS040629-8B			C4070650	7/6/2004	30.14	Pass	29.44	29.97	31.92	32.54
7/7/2004	LCS	AS040629-8	Th/Ac	61	C4070661 B4070661	7/6/2004 7/7/2004	0.3670 5556.4	Pass	0.0000 5529.6	0.0500 5535.6	0.7500 5559.6	0.7500 5565.6
AS040629-8		AS040629-8B			C4070661	7/6/2004						
T6298L		AS040629-8B										
7/7/2004												

Data Package ID: ThAc0405097-1

Abbreviations:  
 Eff - Efficiency  
 Egy - Energy

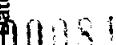
LCL - Lower Control Limit  
 LWL - Lower Warning Limit

UWL - Upper Warning Limit  
 UCL - Upper Control Limit

Date Printed: Monday, July 26, 2004

Cl - The Analysis Date exceeds the Calibration Date by more than 7 days.

Paragon Analytics  
 LIMS Version: 5.042A



# Alpha Spec Calibration Source Re-Certification

R:\INST\ALPHA\CLCRT304.xls

## Primary Certified Source

Source PAI ID 190 was recalibrated by Isotope Products Laboratories on 03-01-2003 and received by PAI on 03-04-2003.

Source ID: 92MIX223027; PAI ID 190 (Labeled #9)		
Total Activity:	3754	dpm
Ref. Date:	3/1/03	
Count Date:	3/22/04	
U-234 Activity:	79.06%	= 2967.90 dpm (decay corrected)
Am-241 Activity:	19.20%	= 719.56 dpm (decay corrected)
Combined Activity:		= 3687.46 dpm (decay corrected)

## Detector 13 Efficiency Determination

Source Serial #	PAI ID	Sequential #	Count Date	Am-241 net cts	U-234 net cts	count dur (s)	Combined cpm	Known dpm	detector efficiency
92MIX223027	190	97-19-103-09	3/22/04	7824.65	32919.75	2100	1164.126	3687.46	31.57%

## Sources 1 through 8 activity determination

Source Serial #	PAI ID	Sequential #	Count Date	Am-241 net cts	U-234 net cts	count dur (s)	detector efficiency	Am-241 dpm	U-234 dpm	combined dpm
92MIX2203026	182	97-19-103-01	3/22/04	13674.65	81078.76	2100	31.57%	1237.59	7337.81	8575.40
92MIX2203028	183	97-19-103-02	3/22/04	15497.65	153089.76	2100	31.57%	1402.57	13854.97	15257.54
92MIX2203024	184	97-19-103-03	3/22/04	72039.65	74346.76	2100	31.57%	6519.75	6728.55	13248.30
92MIX2203021	185	97-19-103-04	3/22/04	22309.65	63564.76	2100	31.57%	2019.07	5752.75	7771.83
92MIX2203025	186	97-19-103-05	3/22/04	102504.65	126055.76	2100	31.57%	9276.90	11408.33	20685.23
92MIX2203022	187	97-19-103-06	3/22/04	77656.69	83352.76	2100	31.57%	7028.11	7543.61	14571.72
92MIX2203023	188	97-19-103-07	3/22/04	46378.65	70580.76	2100	31.57%	4197.37	6387.72	10585.09
92MIX2203029	189	97-19-103-08	3/22/04	34881.65	219992.76	2100	31.57%	3156.87	19909.84	23066.71

## Detector 13 Efficiency Verification

Source Serial #	PAI ID	Sequential #	Count Date	Am-241 net cts	U-234 net cts	count dur (s)	Combined cpm	Known dpm	detector efficiency	% difference from 1st count
92MIX223027	190	97-19-103-09	3/22/04	7546.69	32241.76	2100	1136.813	3687.46	30.83%	2.35%

## Sources 1 through 8 activity re-verification

Source Serial #	PAI ID	Sequential #	Combined Observed	Combined Certified	Percent Difference	Within 5% of Certified value	Yes/No
92MIX2203026	182	97-19-103-01	8575.40	8730.07	1.77%	Yes	
92MIX2203028	183	97-19-103-02	15257.54	15767.93	3.24%	Yes	
92MIX2203024	184	97-19-103-03	13248.30	13517.34	1.99%	Yes	
92MIX2203021	185	97-19-103-04	7771.83	8130.72	4.41%	Yes	
92MIX2203025	186	97-19-103-05	20685.23	20951.92	1.27%	Yes	
92MIX2203022	187	97-19-103-06	14571.72	15242.25	4.40%	Yes	
92MIX2203023	188	97-19-103-07	10585.09	10755.77	1.59%	Yes	
92MIX2203029	189	97-19-103-08	23066.71	23263.22	0.84%	Yes	

\*Sources 185,186,187, & 188 decay corrected to 04/01/03.

\*Sources 182,183,184, & 189 decay corrected to 05/01/03.

OK - R6  
3/22/05  
EM

0000S2



Isotope Products  
Laboratories

An Eckert & Ziegler Company

24937 Avenue Tibbitts  
Valencia, California 91355

Tel 661-309-1010  
Fax 661-257-8303

✓ 1

PAT <sup>187</sup>  
recalibrate 4-15-03

## CERTIFICATE OF CALIBRATION MIXED ALPHA STANDARD SOURCE

Radionuclide A: U-234

Radionuclide B: U-235

Radionuclide C: Am-241

Half Life (U-234):  $(2.454 \pm 0.006) \times 10^5$  years

Half Life (U-235):  $(7.037 \pm 0.011) \times 10^8$  years

Half Life (Am-241):  $432.17 \pm 0.66$  years

Customer:

PARAGON ANALYTICS, INC.

P.O. No.: EW040203/R2193

Catalog No.: MISC-STD

Reference Date: 1-May-03 12:00 PST

Source No.: 92MIX2203026

### Contained Radioactivity:

U-234: 3.354 nCi (124.1 Bq)  
U-235: 0.06566 nCi (2.429 Bq)

Am-241: 0.5793 nCi (21.43 Bq)  
Total Activity: 3.999 nCi (148.0 Bq)

### Physical description:

A. Capsule type: Disk (22 mm OD X 0.79 mm THK)  
B. Nature of active deposit: Electrodeposited and diffusion bonded oxides  
C. Active Diameter: 19 mm  
D. Backing: Stainless steel  
E. Cover: None

Radioimpurities: Not determined

### Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Mar 1998.

### Uncertainty of Measurement:

A. Type A (random) uncertainty:  $\pm 0.7\%$   
B. Type B (systematic) uncertainty:  $\pm 3.0\%$   
C. Uncertainty in aliquot weighing:  $\pm 0.0\%$   
D. Total uncertainty at the 99% confidence level:  $\pm 3.1\%$

### Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 4483  $\alpha/\text{min}$  in  $2\pi$  on 11 Apr 03.

Daniel James Van Dalsum  
Quality Control

15-Apr-03  
Date Signed

IPL Ref. No.: 987-7



# Isotope Products Laboratories

An Eckert & Ziegler Company

24937 Avenue Tibbitts  
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*α 2*

*PAT '83  
Recalibrated 4-15-03*

## CERTIFICATE OF CALIBRATION MIXED ALPHA STANDARD SOURCE

Radionuclide A: U-234  
Radionuclide B: U-235  
Radionuclide C: Am-241  
Half Life (U-234): (2.454 ± 0.006)E+05 years  
Half Life (U-235): (7.037 ± 0.011)E+08 years  
Half Life (Am-241): 432.17 ± 0.66 years

Customer: PARAGON ANALYTICS, INC.  
P.O. No.: EW040203/R2193  
Catalog No.: MISC-STD  
Reference Date: 1-May-03 12:00 PST  
Source No.: 92MIX2203028

### Contained Radioactivity:

U-234:	6.467 nCi (239.3 Bq)	Am-241:	0.6366 nCi (23.55 Bq)
U-235:	0.1135 nCi (4.200 Bq)	Total Activity:	7.217 nCi (267.1 Bq)

### Physical description:

A. Capsule type:	Disk (22 mm OD X 0.79 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxides
C. Active Diameter:	19 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities: Not determined

### Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Aug 1992.

### Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.7%
B. Type B (systematic) uncertainty:	± 3.0%
C. Uncertainty in aliquot weighing:	± 0.0%
D. Total uncertainty at the 99% confidence level:	± 3.1%

### Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 8091 α/min in  $2\pi$  on 11 Apr 03.

Daniel James Van Dalsen  
Quality Control

15-Apr-03  
Date Signed

IPL Ref. No.: 987-7

 Isotope Products  
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Fax 661•257•8303

✓ 3

PAT I.D 184  
recalibrated 4-15-03

## CERTIFICATE OF CALIBRATION MIXED ALPHA STANDARD SOURCE

Radionuclide A: U-234  
Radionuclide B: U-235  
Radionuclide C: Am-241  
Half Life (U-234):  $(2.454 \pm 0.006)E+05$  years  
Half Life (U-235):  $(7.037 \pm 0.011)E+08$  years  
Half Life (Am-241):  $432.17 \pm 0.66$  years

Customer: PARAGON ANALYTICS, INC.  
P.O. No.: EW040203/R2193  
Catalog No.: MISC-STD  
Reference Date: 1-May-03 12:00 PST  
Source No.: 92MIX2203024

### Contained Radioactivity:

U-234:	3.227 nCi (119.4 Bq)	Am-241:	2.866 nCi (106.0 Bq)
U-235:	0.05205 nCi (1.926 Bq)	Total Activity:	6.145 nCi (227.3 Bq)

### Physical description:

A. Capsule type:	Disk (22 mm OD X 0.79 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxides
C. Active Diameter:	19 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities: Not determined

### Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Aug 1992.

### Uncertainty of Measurement:

A. Type A (random) uncertainty:	$\pm 0.6\%$
B. Type B (systematic) uncertainty:	$\pm 3.0\%$
C. Uncertainty in aliquot weighing:	$\pm 0.0\%$
D. Total uncertainty at the 99% confidence level:	$\pm 3.1\%$

### Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 6889  $\alpha/min$  in  $2\pi$  on 11 Apr 03.

Daniel James Van Dalsum  
Quality Control

15-Apr-03  
Date Signed

IPL Ref. No.: 987-7

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✓ 4

PAI ICD OC18S  
(rec'd) from recalibration  
3-28-03

## CERTIFICATE OF CALIBRATION ALPHA STANDARD SOURCE

Radionuclide A: U-234  
Radionuclide B: U-235  
Radionuclide C: Am-241  
Half Life (U-234):  $(2.454 \pm 0.006)E+05$  years  
Half Life (U-235):  $(7.037 \pm 0.011)E+08$  years  
Half Life (Am-241):  $432.17 \pm 0.66$  years

Customer: PARAGON ANALYTICS, INC.  
P.O. No.: EW030603/R2155  
Catalog No.: MISC-STD  
Reference Date: 1-Apr-03 12:00 PST  
Source No.: 92MIX2203021

### Contained Radioactivity:

U-234:	2.731 nCi (101.0 Bq)	Am-241:	0.9325 nCi (34.50 Bq)
U-235:	0.03416 nCi (1.264 Bq)	Total Activity:	3.698 nCi (136.8 Bq)

### Physical description:

A. Capsule type:	Disk (22 mm OD X 0.79 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxides
C. Active Diameter:	19 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities: Not determined

### Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Aug 1992.

### Uncertainty of Measurement:

A. Type A (random) uncertainty:	$\pm 0.8\%$
B. Type B (systematic) uncertainty:	$\pm 3.1\%$
C. Uncertainty in aliquot weighing:	$\pm 0.0\%$
D. Total uncertainty at the 99% confidence level:	$\pm 3.2\%$

### Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 4145  $\alpha/min$  in  $2\pi$  on 18 Mar 03.

Daniel James Chen Dallman  
Quality Control

19-Mar-03  
Date Signed

IPL Ref. No.: 987-2



Isotope Products  
Laboratories

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Valencia, California 91355

Tel 661-309-1010  
Fax 661-257-8303

✓ 5

141 I.D. 06186  
Spec Calibration  
Received 186  
3-28-03

## CERTIFICATE OF CALIBRATION ALPHA STANDARD SOURCE

Radionuclide A: U-234  
Radionuclide B: U-235  
Radionuclide C: Am-241  
Half Life (U-234):  $(2.454 \pm 0.006) \times 10^5$  years  
Half Life (U-235):  $(7.037 \pm 0.011) \times 10^8$  years  
Half Life (Am-241):  $432.17 \pm 0.66$  years

Customer: PARAGON ANALYTICS, INC.  
P.O. No.: EW030603/R2155  
Catalog No.: MISC-STD  
Reference Date: 1-Apr-03 12:00 PST  
Source No.: 92MIX2203025

### Contained Radioactivity:

U-234:	5.486 nCi (203.0 Bq)	Am-241:	3.958 nCi (146.4 Bq)
U-235:	0.09221 nCi (3.412 Bq)	Total Activity:	9.536 nCi (352.8 Bq)

### Physical description:

A. Capsule type:	Disk (22 mm OD X 0.79 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxides
C. Active Diameter:	19 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities: Not determined

### Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Aug 1992.

### Uncertainty of Measurement:

A. Type A (random) uncertainty:	$\pm 0.8\%$
B. Type B (systematic) uncertainty:	$\pm 3.1\%$
C. Uncertainty in aliquot weighing:	$\pm 0.0\%$
D. Total uncertainty at the 99% confidence level:	$\pm 3.2\%$

### Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 10690  $\alpha/\text{min}$  in  $2\pi$  on 18 Mar 03.

Daniel James L. Dawson  
Quality Control

19-Mar-03  
Date Signed

IPL Ref. No.: 987-2

126

AIIO CC 187  
rec'd for recalibration  
3-28-03

## CERTIFICATE OF CALIBRATION ALPHA STANDARD SOURCE

Radionuclide A: U-234  
Radionuclide B: U-235  
Radionuclide C: Am-241  
Half Life (U-234):  $(2.454 \pm 0.006)E+05$  years  
Half Life (U-235):  $(7.037 \pm 0.011)E+08$  years  
Half Life (Am-241):  $432.17 \pm 0.66$  years

Customer: PARAGON ANALYTICS, INC.  
P.O. No.: EW030603/R2155  
Catalog No.: MISC-STD  
Reference Date: 1-Apr-03 12:00 PST  
Source No.: 92MIX2203022

### Contained Radioactivity:

U-234:	3.592 nCi (132.9 Bq)	Am-241:	3.279 nCi (121.3 Bq)
U-235:	0.08556 nCi (3.166 Bq)	Total Activity:	6.957 nCi (257.4 Bq)

### Physical description:

A. Capsule type:	Disk (22 mm OD X 0.79 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxides
C. Active Diameter:	19 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities: Not determined

### Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Aug 1992.

### Uncertainty of Measurement:

A. Type A (random) uncertainty:	$\pm 0.8\%$
B. Type B (systematic) uncertainty:	$\pm 3.1\%$
C. Uncertainty in aliquot weighing:	$\pm 0.0\%$
D. Total uncertainty at the 99% confidence level:	$\pm 3.2\%$

### Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 7799  $\alpha/min$  in  $2\pi$  on 18 Mar 03.

  
Daniel James Van Dijken  
Quality Control

19-Mar-03  
Date Signed

IPL Ref. No.: 987-2

 Isotope Products  
Laboratories

An Eckert & Ziegler Company

24937 Avenue Tibbitts  
Valencia, California 91355

Tel 661-309-1010  
Fax 661-257-8303

✓ 7

PA IP 188  
req'd for recalibration  
3-28-03

## CERTIFICATE OF CALIBRATION ALPHA STANDARD SOURCE

Radionuclide A: U-234  
Radionuclide B: U-235  
Radionuclide C: Am-241  
Half Life (U-234):  $(2.454 \pm 0.006) \times 10^5$  years  
Half Life (U-235):  $(7.037 \pm 0.011) \times 10^8$  years  
Half Life (Am-241):  $432.17 \pm 0.66$  years

Customer: PARAGON ANALYTICS, INC.  
P.O. No.: EW030603/R2155  
Catalog No.: MISC-STD  
Reference Date: 1-Apr-03 12:00 PST  
Source No.: 92MIX2203023

### Contained Radioactivity:

U-234:	2.895 nCi (107.1 Bq)	Am-241:	1.953 nCi (72.26 Bq)
U-235:	0.02502 nCi (0.9257 Bq)	Total Activity:	4.873 nCi (180.3 Bq)

### Physical description:

A. Capsule type: Disk (22 mm OD X 0.79 mm THK)  
B. Nature of active deposit: Electrodeposited and diffusion bonded oxides  
C. Active Diameter: 19 mm  
D. Backing: Stainless steel  
E. Cover: None

Radioimpurities: Not determined

### Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Aug 1992.

### Uncertainty of Measurement:

A. Type A (random) uncertainty:  $\pm 0.8\%$   
B. Type B (systematic) uncertainty:  $\pm 3.1\%$   
C. Uncertainty in aliquot weighing:  $\pm 0.0\%$   
D. Total uncertainty at the 99% confidence level:  $\pm 3.2\%$

### Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 5463  $\alpha/\text{min}$  in  $2\pi$  on 18 Mar 03.

Daniel James Van Dalsen  
Quality Control

19-Mar-03  
Date Signed

IPL Ref. No.: 987-2



Isotope Products  
Laboratories

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24937 Avenue Tibbitts  
Valencia, California 91355

Tel 661-309-1010  
Fax 661-257-8303

✓ 8

PAI ID 189  
recd 4-21-03  
recalibrated 4-15-03

## CERTIFICATE OF CALIBRATION MIXED ALPHA STANDARD SOURCE

Radionuclide A: U-234  
Radionuclide B: U-235  
Radionuclide C: Am-241  
Half Life (U-234): (2.454 ± 0.006)E+05 years  
Half Life (U-235): (7.037 ± 0.011)E+08 years  
Half Life (Am-241): 432.17 ± 0.66 years

Customer: PARAGON ANALYTICS, INC.  
P.O. No.: EW040203/R2193  
Catalog No.: MISC-STD  
Reference Date: 1-May-03 12:00 PST  
Source No.: 92MIX2203029

### Contained Radioactivity:

U-234:	9.048 nCi (334.8 Bq)	Am-241:	1.433 nCi (53.02 Bq)
U-235:	0.1771 nCi (6.553 Bq)	Total Activity:	10.66 nCi (394.4 Bq)

### Physical description:

A. Capsule type: Disk (22 mm OD X 0.79 mm THK)  
B. Nature of active deposit: Electrodeposited and diffusion bonded oxides  
C. Active Diameter: 19 mm  
D. Backing: Stainless steel  
E. Cover: None

Radioimpurities: Not determined

### Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter for total alpha activity. Individual nuclide ratios were taken from those determined in Mar 1998.

### Uncertainty of Measurement:

A. Type A (random) uncertainty: ± 0.5%  
B. Type B (systematic) uncertainty: ± 3.0%  
C. Uncertainty in aliquot weighing: ± 0.0%  
D. Total uncertainty at the 99% confidence level: ± 3.0%

### Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 11950 α/min in  $2\pi$  on 11 Apr 03.

Daniel J. James Van Dijken  
Quality Control

15-Apr-03  
Date Signed

IPL Ref. No.: 987-7